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THE AMERICAN FORESTRY ASSOCIATION.

THE American Forestry Association held its summer meeting at Springfield, Massachusetts, on September 4th and 5th, in connection with the American Association for the Advancement of Science.

The President of this Association, the Hon. J. Sterling Morton, Secretary of Agriculture, was prevented by official business from attending, but sent his regards together with expressions of deep interest in the objects of the meeting.

Capt. Francis H. Appleton, Vice-President, from Massachusetts, presided and opened the session by a brief address detailing the condition of forestry in Massachusetts and referring to the action of the State Board of Agriculture through its Forestry Division. The first business was the appointment of Messrs. Fernow, Higley, Moses, Walker and Appleton as a Committee on Resolutions to report at the end of the session. The Hon. G. F. Talbot, of Maine, made an address in which he advocated that all worthless lands forfeited by tax sales be permanently held by the State and devoted to the purpose of the production of trees, such lands being admirably adapted to this end. He spoke of the fire laws of Maine and stated that the adverse interests of forest owners was the great obstacle to any reform in the proper control. Under a sharp competition the land was stripped of everything salable and the refuse left where it happened to fall, thus ultimately becoming through its inflammability a menace to all neighboring property.

Mr. George H. Moses, Secretary of the New Hampshire Forestry Commission, reviewed the history of legislative attempts to provide suitable protection to the forests, and spoke of the creation of the present

Commission organized to investigate the extent and character of the forest cover, the removal of lumber, the annual receipts and the general relation of forests to climate, water and health. They are empowered simply to investigate, but much of their energy has been given to attempts to convince the lumber men that it is for their personal interest as well as that of the State to introduce less wasteful and destructive methods. They are also striving to preserve some of the natural beauties of the White Mountain region, as the summer resorts, if destroyed or injured, will cause great annual loss to the State.

Mr. Joseph B. Walker, of Concord, New Hampshire, followed with a description of the present condition of the forests, especially those in the northern portion of the State. Here large areas are owned by individuals whose sole object is to make the most money in the shortest period, and who have no interest in obtaining a future crop of trees. Everything is cut which can be sold, either for lumber or matches. Vast sections are denuded one after the other, the fires in the 'slashings' sweeping the ground clean after the lumber men have left. There is a beginning, mainly from the sentimental side, to make an attempt to prevent this great destruction, and the fire laws have been so improved that the Selectmen or County Commissioners are required to appoint fire wardens, whose duties include the watching for fires and the summoning of aid to prevent their spread. No penalty for failure is provided, but popular sentiment is being aroused to such an extent as to render the law generally effective. The farmer is beginning to appreciate the necessity of the forests, as these if properly managed will furnish him opportunity for labor during the winter months. At present he labors seven months of the year and from his farm alone cannot derive revenue for the remaining five months.

Rev. Julius H. Ward, of the editorial staff of the Boston *Herald*, read a paper on the present situation in the White Mountains. He noted the increased regard being expressed by lumbermen for the young trees which ultimately should become valuable for lumber. He described the ordinary operations and stated that the companies now at work in the White Mountains expected to cut everything before them, not leaving a stick of any value.

Mr. Charles Eliot, of the firm of Olmestead & Eliot, of Brookline, Mass., read a paper on the new public forests near Boston, illustrating this by maps of the locations of these forests, and described their general characteristics. The most important of these public reservations is the Blue Hills area, consisting mainly of rugged hills and swamps. Next in importance are the Middlesex Falls, and besides these are numerous smaller localities notable for the beauty of their scenery. The chief enemy to these is fire, and to guard against this, the larger reservations are blocked out into fire districts, and watchmen employed to patrol the grounds.

Mr. E. H. Forbush, Director of Field Work of the Gypsy Moth Department of the Massachusetts Board of Agriculture, spoke of the work in confining this insect pest within certain limits. It originated in specimens imported by an entomologist, these escaping and multiplying until the trees and bushes within many towns were destroyed as completely as by fire. By means of sufficient appropriations it would be possible to exterminate this insect, but Massachusetts has only granted a sum sufficient to hold it in check. Thus there is constant danger that the moth may escape and start new colonies in every direction. If allowed to spread it may overrun the whole country. He stated that the native birds will not eat the eggs of this insect, but that possibly some foreign birds which

eat the eggs in their own country might be imported.

Mr. Cornelius C. Vermeule, of the New Jersey Geological Survey, read a paper upon forests and rivers, this relating mainly to the conditions within the State of New Jersey, reference being made to data from Massachusetts, New York and Pennsylvania. In his conclusions he stated that the river measurements failed to indicate any notable effect of forests upon evaporation or upon the very highest or lowest rate of flow. The measurements do show what is quite as important, namely, a more equable flow, fewer floods, and shorter periods of extreme low water upon well forested catchments. Some of Mr. Vermeule's conclusions were called in question by Mr. Fernow as not being applicable beyond the areas studied.

Hon. Warren Higley, of New York, spoke of the progress of legislation in his State, and described the inception and growth of the Adirondack Park. The lands within the Park limits are being acquired by the State through tax sales or by purchase, excepting such as are owned or controlled by clubs or corporations whose interests in forest protection are identical with those of the State. It was the original intention to manage this Park upon rational principles and dispose of the ripe trees for timber wherever this could be done without injury, but the Constitutional Convention adopted a provision against the sale of any timber upon lands owned or to be acquired by the State, the people thus putting themselves upon record as being able to buy and maintain these forests without the aid of revenue from the sale of forest products.

Colonel William Fox, Superintendent in charge of the State Forests, briefly described the organization of the Commission under which he was employed, and stated that it was the intention to purchase 80,000 acres as soon as possible. The forests could undoubtedly be improved by cutting, but since this was prohibited by the Constitution, a rational system of forestry must be held in abeyance for the present.

Prof. J. C. Smock, State Geologist of New Jersey, stated that some of the largest land holdings in that part of the country are in southern New Jersey. The Geological Survey is performing, to a certain extent, some of the functions of a forest commission and is making examinations as to the relation of forests to water supply and sanitary conditions. The agricultural interests are as a rule subordinate in New Jersey to the question of water supply, especially in the northern part of the State, where are situated the great metropolitan districts. For the southern part the main source of anxiety is the forest fires, one of these alone having burned over and destroyed probably a million dollars' worth of lumber and other property. Such a fire leaves only the bare white sand, destroying even the soil.

Baron Beno Reinhardt von Herman, Chamberlain to the King of Würtemberg, Forestry Councillor and at present Attaché Forestry and Agriculture to the German Legation, read a brief address upon forestry management in Germany, and spoke of the special education of the foresters in colleges devoted to this purpose, and their subsequent training by practical experience in the woods.

The remaining papers on the program for Tuesday were not read owing to the absence of their authors. Adjournment was taken till Wednesday, September 4th.

On Wednesday morning, September 4th, the session was called to order by Vice-President Appleton, the first paper being by Mr. T. S. Gold, Secretary of the Board of Agriculture of Connecticut. He spoke of the causes tending to re-establish wood growth in his State, these being mainly the decrease of profit in wood cutting, owing to the extinction of the iron furnaces. Many

trees are being set by the roadside and the State has enacted legislation protecting such trees. Spikes having the letter 'C' in the head are to be provided, and when driven into one of the roadside or shade trees this spike must not be removed even by the owner, and any destruction or injury to the tree is punishable by heavy penalty. The drought of the past year has destroyed many trees, especially the chestnut, resulting in widespread injury to woodlands.

Dr. B. G. Northrop, of Clinton, Connecticut, described the interest shown in Arbor Day in the Hawaiian Islands and in Japan, at the time of his visit to those countries. In Japan the Emperor's birthday has been designated as Arbor Day, memorial trees being planted in his honor. Great enthusiasm was expressed and interest shown in the reclamation of sea coast and the planting of the sand dunes.

A letter from the Hon. J. Sterling Morton, President of the Association, was read. This called attention to the necessity of urging upon the State legislation compelling the proper care of waste from timber cutting in order to prevent forest fires. Mr. Morton also wrote of the necessity of bringing about coöperation between the United States Geological Survey and the Forestry Division of the Agricultural Department, in order that during the preparation of the topographic map the forest areas might be properly represented. He showed that by slight additional expense it would be possible for an expert to classify the woodlands while the map was being made, and obtain the material for a report upon the condition and value of the forests, and the steps to be taken for the proper protection or treatment of these resources. By this means the completed map would show not only the altitude and slopes of the country, the roads, trails and improvements, but also the character and extent of the timber.

Mr. F. H. Newell, Secretary of the Association, spoke of the progress of the great map of the United States now being prepared by the United States Geological Survey, and described the methods of representing wooded areas, dwelling upon the benefits which would follow the more accurate designation of timber lands. By suitable coöperation of the Agricultural Department, it might be possible to concentrate efforts upon the areas covered by the national forest reservations and complete the mapping and description of these within a few years. Remarks were made by Messrs. Talbot, Moses, Elwyn, Pinchot, Smock and others, showing the inaccuracy of the present information concerning the forests and the difficulties of obtaining exact facts through local officials.

Mr. George T. Powell, of Ghent, New York, spoke upon the benefit to the farmers of the preservation of forest areas. He stated that too many unproductive acres were now cultivated, and that in the Eastern States often the cost of production exceeded the value received. By tilling a smaller number of acres with greater care, and devoting the poorer lands to the growth of timber far larger results might be obtained.

At this point Mr. Appleton resigned the chair to Hon. Warren Higley, Vice-President for New York. A discussion was entered into as to the necessity and value to this Association of a forestry journal. This was participated in by Messrs. Fernow, Newell, Talbot, Ward and Pinchot, the general opinion being that such a journal was highly desirable, provided the editorial and business management could be undertaken by any competent person. On motion of Dr. G. B. Northrop the matter was referred to the Executive Committee, with power to act.

Mr. B. E. Fernow, Chief of the Forestry Division, at the beginning of the afternoon session made a statement as to the progress

in National forestry legislation and reviewed the history of attempts made in the past to secure passage of bills endorsed by this Association.

Mr. R. U. Johnson, of the *Century Magazine*, then spoke of the action of the New York Board of Trade and Chamber of Commerce, and urged the advisability of endorsing the resolution of that body calling for the creation by Congress of a Forestry Commission, consisting of three persons empowered to examine into the forest conditions of the country.

Mr. Gifford Pinchot then read a paper upon the present condition of the National forests and the necessity of action in protecting these. He held that since past efforts of this Assoaiation had been in a large degree ineffectual, that the proper method of procedure was through a Forest Commission such as that proposed by Mr. Johnson. His views were strongly controverted by Mr. B. E. Fernow on the ground that the time was ripe for action rather than for investigation, and that Congress would be more likely to consider legislation already discussed during the past session rather than to take a backward step in the appointment of a Commission. The matter was urged by Messrs. Johnson and Pinchot, and under a suspension of the rules the following resolution was adopted:

Resolved, That we, this Association, join with the New York Chamber of Commerce and Board of Trade in hearty advocacy of the establishment of a Forestry Commission of three members to make a thorough investigation of the public forest lands and to make recommendations concerning their disposition and treatment, and the Executive Committee is hereby directed to represent the Association in support of such legislation.

Prof. Dwight Porter, of the Massachusetts Institute of Technology, read a paper upon the fluctuations of water supply in Connecticut river and the possible connection between these and forest removal. His general conclusion was that as far as the flow of the lower river is concerned there is no proof of permanent injury through cutting of the forests at the head waters. Mr. Talbot called attention to the fact that taking the basin as a whole there might be at present as much growing timber as formerly since on this point there are no statistics available.

Mr. Leonard W. Ross, of Boston, read a paper upon seacoast planting as practiced on the Province lands of Cape Cod, and described the attempts being made to prevent the shifting sands at the extremity of Cape Cod from injuring the settlements and harbor. He spoke of the various kinds of grasses and shrubs which have been planted to hold the sands, and of the results attained, and exhibited specimens showing the cutting of the twigs due to the sand carried by the wind.

Mr. H. C. Bliss, of Springfield, Massachusetts, read a description of methods of planting trees in the vicinity of his city. He has planted an average of 100 trees a year for over twelve years, and has had great success in thus adding to the beauty of the various streets. He described his methods and offered many practical suggestions.

Mr. John M. Woods, of Boston, Mass., described the changes in the hard wood trade during the past thirty years, and spoke of the uses of the more valuable of the ornamental woods native in the eastern and southern parts of the United States.

Hon. G. F. Talbot presented a formal invitation from the Governor of Maine and the Mayor of Portland, inviting the Association to hold a meeting at Portland, Maine, during the next summer. Invitations were referred to the Executive Committee for action.

The Committee on Resolutions then made its formal report, and the following resolu-

tions were adopted paragraph by paragraph, after which the Association adjourned:

Resolved, That the American Forestry Association learns with satisfaction of the recent enactment of laws for the protection of forest property against destruction by fire in Wisconsin and Minnesota, and of the successful operation of such laws in Maine, New Hampshire and New York, deprecating at the same time the continuance of forest destruction by fire in other States and especially on the public domain.

That the question of dealing with forest fires is still the first and most important one to be settled in nearly all the States of the Union before rational forestry methods can become practicable.

That inasmuch as forestry property is taxed for the support of government, it has the same right to consideration and protection as other property and that the Legislatures of the different States which have no efficient forest-fire laws are recommended to provide the same.

That the policy of establishing forest reservations and parks is to be encouraged, and for this purpose it is recommended that timber lands offered for sale for non-payment of taxes be acquired by the State and held to form the nucleus of State forest reservations.

That it is the first duty of Congress in regard to the public timber lands to enact proper legislation for the National protection and administration of the forest reservations and unreserved timber lands, and we appeal to the Public Lands Committees of the Senate and House of Representatives to secure the passage of bills which received the sanction of the Senate and House of Representatives in the 53d Congress, and failed to become laws only for lack of time for consideration of amendments in conference.

That the American Forestry Association, recognizing that a practical advance in rational forestry methods requires the services of men trained in forestry practice, indorse the legislation proposed in the last Congress by Mr. Hainer, and expresses the hope that the same will be enacted during the coming Congress.

That the knowledge of the extent and conditions of our forest resources is a necessary basis for intelligent forest legislation, and that therefore the American Forestry Association recommends the coöperation of various government departments as far as practicable in ascertaining these areas and conditions, and especially recommends that both a topographic and forestal survey of National Forest Reserves be instituted.

F. H. Newell,
Corresponding Secretary.

Washington, D. C.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.

The second annual meeting of the Society for the Promotion of Engineering Education was held at Springfield, Mass., on Sept. 2, 3 and 4. This Society was organized in 1893 at the close of the session of the educational section of the International Engineering Congress, whose proceedings were published in the first volume of its transactions. It had 156 members at the close of the meeting held in Brooklyn in 1894. The sessions of the Society are largely devoted to the discussion and reading of papers, nearly all the business being transacted by a Council composed of 21 members, selected from 21 different engineering colleges.

The President of the Society, Professor George F. Swain, opened the first session with an address on the relation between mental training and practical work in engineering education. He alluded to the strong tendency toward practical engineering work as often dangerous in preventing a thorough educational development. The opinions of the public and of some engineers are often

directly opposed to those of teachers of long experience, and hence the importance of the discussions in this Society. Principles are more important than rules, and a broad foundation gives the best opportunity for success. The success of the middle-aged engineers of to-day, who had few opportunities for practical work during their college courses, is perhaps largely due to their broad and thorough training in fundamental subjects. The selection of teachers on the basis of practical experience alone seems a dangerous one. In short, education is more important than engineering in the school and college.

The report of the Secretary, Professor J. B. Johnson, brought out the fact that a considerable number of copies of the two volumes of transactions had been sold in Europe, and that the methods of laboratory instruction in the United States had formed the subject of a lengthy discussion in the Society of Engineers and Architects of Germany.

REQUIREMENTS FOR ADMISSION.

The Committee appointed at the Brooklyn meeting to collect facts regarding the requirements for admission to engineering colleges presented a report of progress through its chairman, Professor F. O. Marvin. Circulars had been sent to every engineering college in the United States and Canada and 55 replies had been received, which were tabulated in five groups by States. The New England, Middle and Central States are strong in mathematical requirements, over 50 per cent. in each of these groups requiring algebra through quadratics and plane and solid geometry, while in the West and South only 24 and 4 per cent., respectively, require the same amount. The Central States are much stronger in science requirements than the other groups, 14 colleges requiring an average of three or more science subjects. In advanced English requirements the Eastern colleges are the strongest. In foreign languages the central group stands highest. Drawing is required by only ten per cent. of all the colleges, and the larger part of these are in the Central or Western States.

In all the groups there is seen a strong tendency to increase the mathematical requirements, to abandon formal grammar and substitute a better knowledge of the English language and literature, and to introduce either French or German.

As to the conditions allowed and the time for their removal the replies show that the practice is subject to wide variation. The same is the case with respect to the acceptance of certificates in place of examination. It is significant, however, that out of 55 colleges 34 should report the certificate plan as more or less satisfactory.

Circulars were also sent to nearly 500 preparatory schools and 148 replies were received. Of these 59 think an increase in the requirements for admission to engineering colleges is desirable, and 75 are prepared to advance their courses to meet such an increase; 105 schools favor uniformity in requirements. With respect to the certificate plan only one-third think that it should be extended, those in the East favoring examinations and those in the South and West favoring admission by certificate.

The Committee refrained from presenting opinions upon the facts collected, and it was continued in order to further study the material on hand and report at the meeting in 1896.

PAPERS ON SEPTEMBER 2.

'The Scope of an Engineering School,' by Professor William G. Raymond, took the ground that culture and language studies should be mostly confined to preparatory courses, and that mathematics, except arithmetic, should be left to the engineer-

ing college. Here algebra and geometry should be begun and a broad and thorough training be given in general and technical science, while the specialties of engineering, like bridge and locomotive design, should be left to a post-graduate year. These views met with decided opposition from Mr. William Kent, who advocated geometry, algebra and Latin as most important subjects to be taught in the high schools.

'The Requirements of Engineering Colleges in Non-professional Studies,' by Professor Louis E. Reber, gave statistics relating to 37 institutions. The various subjects were classed as culture, indirect technical and technical. The average time devoted to culture studies was given as 16 per cent., while the technical subjects occupy from 50 to 60 per cent. Three colleges have no language studies in their technical courses, although requiring more or less for admission. The tendency toward specialization in engineering work seemed marked, one institution having no culture studies of any kind in the entire four years of the course.

'Graphic Methods in Engineering Education,' by Professor L. M. Hoskins. This paper urged the importance of more thorough instruction, not only in graphic studies, but also in general analysis by graphics. It was claimed that geometry often yields almost wholly to algebra as an instrument of investigation and that this results in a lack of clearness. The discussion on this paper developed the general opinion that technical students are usually very weak in arithmetical computations, and that graphic methods should not be used for cases where a slide rule gives sufficient precision.

'The Elective System Applied to Courses in Mining,' by Dr. M. E. Wadsworth, gave an outline of the method adopted at the Michigan Mining School. The discussion on this paper by several members indicated that elective courses in engineering were not in general regarded with favor, as the proper sequence of studies can not be thus well maintained. The experience of the Massachusetts Institute of Technology was cited as tending to a restriction of the elective system.

'Specifications for Text-books,' by Professor Ira O. Baker, treated of the principles which should be kept in view in preparing a text-book. Typographical arrangement, subdivisions, nomenclature and notation were discussed in a suggestive manner. The practice of publishers in bringing out volumes with wide margins was somewhat severely criticised in the discusion which followed, as also was the practice of inserting appendices filled with matter clipped from periodicals.

'The Place of Drawing and Shop Work in Engineering Schools,' by Professor C. H. Benjamin. This paper advocated a prominent place for free-hand drawing, it being regarded as equally important with mechanical drawing. Shop work should be taught to illustrate principles as well as for the advantages of manual training. Students should be required to pay for work that they spoil. The educational value of both drawing and shop work was regarded as high. In the discussions of this paper the methods of the workshops of the Worcester Polytechnic Institute were described by the Superintendent.

PAPERS ON SEPTEMBER 3.

'Theses and Degrees,' by Professor Storm Bull, was a plea for the propriety of giving the bachelor's degree at the completion of a course of technical study. The professional degree of civil or mechanical engineer properly demands a thesis of a different character from that prepared for the bachelor's degree, and should be given only after two or three years of practice. If a third degree is advisable after advanced study it should be Doctor of Engineering

rather than Doctor of Philosophy. The discussion which followed showed a general agreement with these views; it also brought out opinions that theses are of great educational value and that they should be prepared by students with little or no assistance from instructors.

'Modified Requirements for Students who have taken full Liberal Courses,' by Professor Ira N. Hollis. This paper claimed that, with a proper arrangement, a classical graduate could complete an engineering course in one or two years. The greatest difficulty in doing this seems to lie in the fact that the teaching of mathematics in liberal courses is conducted without reference to practical applications.

'Graduate Study in Engineering Courses,' by Professor William H. Burr, asserted that the value of these graduate courses is small compared with those in literary institutions. Four years of study in college is sufficient for most men who intend to follow the practice of engineering.

'The Economic Element in Technical Education,' by Professor L. S. Randolph, advocated the discussion of the commerical side of engineering problems, and the undesirability of making computations to an unnecesssary degree of precision. A study of questions of cost is often of essential importance, engineering being in fact the art of economic construction.

'Unsymmetrical Development of the various courses in Engineering Colleges,' by Prof. F. R. Hutton, favored a strong executive control in order to prevent one department from growing at the expense of others.

'The Engineer of the Twentieth Century,' by Elmer L. Corthell, was a vigorous plea for more thorough education on a broad systematic plan. Technical education was claimed to possess special advantages in training the mind so as to render it capable of being of most service to society and humanity. The boys of to-day who are to be engineers of the twentieth century were advised to secure a broad, liberal education before beginning the special study of engineering.

The afternoon of September 3d was devoted to a visit of inspection to the dam under construction at Holyoke, and also in observing the testing of turbines at the works of the Holyoke Water Power Company.

PAPERS ON SEPTEMBER 4.

On the morning of this day five papers on courses in the physical sciences were presented. Professor C. L. Mees discussed Physics, dwelling upon the importance of precision of nomenclature and in the use of units of measurement, also claiming that dynamics should properly be a part of the course in physics. Professor G. C. Comstock treated of Astronomy, showing the value of the precise training in observation and computation to every engineer. Professor R. S. Woodward's paper on Mechanics dwelt on the fundamental definitions and concepts, particularly those of force, mass and acceleration. These papers led to many interesting discussions by T. C. Mendenhall, Wm. Kent, J. Galbraith and others.

A second class of papers treated of the professional studies in engineering courses, of the subjects and the time to be given to each. Professor C. L. Crandall gave a tabulation of these for the course in civil engineering. Mr. C. C. Brown, city engineer of Indianapolis, discussed a course in sanitary engineering, claiming such specialization to be highly advantageous. Professor Mansfield Merriman, in discussing geodetic engineering, expressed his opposition to a specialized four years' course in this subject, saying that the aim should be, not training in a trade, but education, that is, the development of the powers of the mind. The discussion on these papers brought out

many opinions in opposition to trade specialization in engineering colleges, and many others in favor of thoroughness and precision in all technical work.

'Mechanical Engineering,' by Prof. H. W. Spangler, presented statistics showing the lines of work followed by graduates of mechanical engineering courses; out of 587 graduates all but 9 had followed their chosen profession. The relative importance of laboratory and shop work was treated at length.

'Mining Engineering Laboratories,' by Professor H. O. Hofmann, fully detailed the equipment and methods of work in the laboratories of the Massachusetts Institute of Technology, where 325 hours of practical work are required of each student in mining.

'A Course of Instruction in Engineering Materials,' by Professor J. B. Johnson, gave a comprehensive outline of both the theoretic and practical divisions of mechanics of materials, the laboratory work recommended being about fifty hours in length. The proper kinds of testing machines for the use of students received an extended consideration in the discussion.

The five sessions of the meetings were not sufficient for the reading of all the papers presented; three were read by title, their authors being absent. The time for discussion also often proved too limited. Perhaps the most interesting discussion of the session was that between the engineers and the physicists regarding the units of force best adapted for use in the teaching of mechanics.

THE NEXT MEETING.

It was decided to hold the next annual meeting at Buffalo, beginning on August 20, 1896. The following officers were elected: President, Mansfield Merriman, of Lehigh University; Vice-Presidents, F. O. Marvin, of the University of Kansas, and Cady Staley, of the Case School of Applied Science; Secretary, C. Frank Allen, of the Massachusetts Institute of Technology; Treasurer, J. J. Flather, of Purdue University.

The number of new members elected at this meeting was 33, thus bringing the total membership to 189, representing about 75 technical colleges. The number of members and guests present at the Springfield meeting was nearly 100. There is now little doubt but that the Society will have a great and lasting influence in shaping the development of engineering education.

THE SECOND SUMMER MEETING OF THE AMERICAN MATHEMATICAL SOCIETY.

The Second Summer Meeting of the American Mathematical Society was held in the High School building at Springfield, Mass., on August 27th and 28th. Among those present were: Prof. A. L. Baker, Dr. J. H. Boyd, Prof. C. H. Chandler, Prof. L. L. Conant, Prof. C. L. Doolittle, Prof. W. P. Durfee, Prof. E. Frisby, Dr. G. D. Gable, Dr. J. W. L. Glaisher, Prof. A. Hall, Jr., Prof. Ellen Hayes, Dr. G. W. Hill, Prof. W. Woolsey Johnson, Mr. P. A. Lambert, Prof. J. McMahon, Prof. M. Merriman, Prof F. Morley, Prof. H. B. Newson, Prof. W. F. Osgood, Prof. M. I. Pupin, Mr. R. A. Roberts, Mr. C. H. Rockwell, Prof. J. B. Shaw, Prof. W. E. Story, Prof. H. Taber, Prof. J. M. Van Vleck, Prof. E. B. Van Vleck, Prof. C. A. Waldo, Prof. H. S. White, Prof. J. M. Willard, Prof. C. B. Williams, Prof. F. S. Woods and Prof. R. S. Woodward.

The President, Dr. G. W. Hill, occupied the chair. Two sessions were held each day, meeting respectively at 10 A. M. and 2:30 P. M. The following papers were read:

1. *The periodic solution as a first approximation in the lunar theory:* Dr. G. W. Hill.
2. *The linear vector operator of quaternions:* Prof. J. B. Shaw.
3. *A new application of quaternions to geometry:* Prof. J. B. Shaw.

4. *On a generalization of Weierstrass's equation with three terms:* PROF. F. MORLEY.
5. *Formulas for the sides of rational plane triangles:* DR. ARTEMAS MARTIN.
6. *Partial linear transformations of ternary quantics and their concomitants:* PROF. J. MCMAHON.
7. *An introduction to the integrell calculus:* PROF. W. H. ECHOLS.
8. *On the expansion of a uniform function of a real variable without use of derivatives:* PROF. W. H. ECHOLS.
9. *On continuous functions without differential coefficients:* MR. P. A. LAMBERT.
10. *Concerning Jordan's linear substitution groups:* PROF. E. H. MOORE.
11. *Algebraic symbols and* $\sqrt{-1}$*:* PROF. A. L. BAKER.
12. *An application of the method of conformal representation to the study of related differential equations:* PROF. E. B. VAN VLECK.
13. *On the differential equations of certain systems of conics:* MR. R. A. ROBERTS.
14. *On bilinear forms:* PROF. H. TABER.
15. *Elementary proof of the quarternion associative principle:* PROF. A. S. HATHAWAY.
16. *Asymptolic lines on a circular ring:* PROF. H. MASCHKE.

Dr. Hill's paper at the time of its presentation was already in type for publication in the *Astronomical Journal*. Its object is to obtain the values of the coefficients of the periodic inequalities having the multiples of the mean angular distance of the Moon from the Sun as arguments when the inclination of the lunar orbit and the two excentricities are neglected. It is very desirable to have these coefficients with a high degree of accuracy in order to effect their useful employment in the further determination of the motion of the perigee and node, and in fact of all the other coefficients of the periodic inequalities. This work has been done previously by the author in the *American Journal of Mathematics*, Vol. I., but in neglecting the lunar mass and the solar parallax. Mr. Ernest W. Brown has in the same journal supplemented these researches, but still leaving out of consideration the mass of the Moon.

Professor Shaw's first paper is a development of the linear vector operator of quaternions in the form of a scalar part and two vector parts, also as a tensor and a versor, and finally as a sum of nine operators. The forms are similar to those obtained in the articles of Professor Taber (*Amer. Jour. Math.*, Vols. 12, 13), but are here developed entirely from quaternion expressions and not from matrices. It was stated that this paper would be offered to the *American Journal of Mathematics* for publication.

Professor Shaw's second paper applies the quaternion calculus to homogeneous geometry of two dimensions. In the expression $\zeta = xi + yj + zk$, x, y, z, are proportional to the areas PBC, PCA, PAB respectively, where the point P is referred to the fundamental triangle ABC. By this convention propositions of projective geometry are easily proved, and especially such propositions of modern geometry as those of the Lemoine-Brocard type. The author expected to contribute this paper to the *Annals of Mathematics*.

Professor Morley's paper will be published in the *Bulletin of the American Mathematical Society*. It contains a simple generalization of the formula

$$\begin{aligned}&\sigma(u+u_1)\,\sigma(u-u_1)\,\sigma(u_2+u_3)\,\sigma(u_2-u_3)\\ &+\sigma(u+u_2)\,\sigma(u-u_2)\,\sigma(u_3+u_1)\,\sigma(u_3-u_1)\\ &+\sigma(u+u_3)\,\sigma(u-u_3)\,\sigma(u_1+u_2)\,\sigma(u_1-u_2)=0\end{aligned}$$

In Dr. Martin's paper a large number of formulæ are deduced for calculating rational numbers which represent the sides of triangles having a rational area. Among them are, for the case of a right angled triangle,

$$x=2pq, \quad y=p^2-q^2, \quad z=p^2+q^2,$$

and, for the case of an oblique triangle,

$$\begin{aligned}x&=(p^2+q^2)\,(r^2-s^2),\\ y&=2rs\,(p^2+q^2)\pm 2s^2\,(p^2-q^2),\\ z&=(p^2+q^2)\,(r^2+s^2),\pm 3rs\,(p^2-q^2),\end{aligned}$$

in which x, y, z denote the sides, and p, q, r, s, any entire numbers whatever. The paper, which contains many numerical applications, will be printed in the *Mathematic-*

al Magazine. In the absence of Dr. Martin his paper was read by the Secretary.

Semi-invariants of a ternary quantic satisfy some, but not all, of the six differential equations which characterize invariants. Professor McMahon's paper shows how to distinguish between those semi-invariants which are the sources of covariants and those which are the sources of semi-covariants, and gives a simple method of deriving from the latter all the coefficients of the semi-covariant, or of a semi-contravariant if desired. A systematic geometrical interpretation of these three kinds of semi-concomitants is presented and appears to be particularly useful in cartesian coordinates. This paper is intended for the *Annals of Mathematics.*

In the absence of Professor Echols his two papers were presented by the Secretary. The first one was the second section of an essay 'On the Differell and Integrell Calculus,' the preceding section having been read at the May meeting of the Society. Professor Echols approaches the infinitesimal calculus from the calculus of finite differences. He considers the latter, however, in a greatly generalized form. A differell is defined to be the limit of a ratio whose terms are the n-th differences of the function and the independent variable. An integrell is a differell of a negative index. The applications presented consisted chiefly in the expansion of functions in terms of differells and integrells. In the second paper some of the more novel results were translated into the language of ordinary calculus.

Mr. Lambert attempted to show that functions of which Weierstrass's derivativeless function is the type may be so considered geometrically that their curves will have determinate tangents. In order to secure agreement of the analytic result with the geometric he found it necessary to replace Weierstrass's limitation of h,

$$\tfrac{1}{2}\frac{\pi}{a^n} < h < \tfrac{3}{2}\frac{\pi}{a^n}, \text{ by } 0 < h < \varepsilon\frac{\pi}{a^{2n}},$$

n increasing indefinitely, and ε being any finite quantity.

In Professor Moore's paper a tactical configuration is established which exactly defines Jordan's linear substitution group when taken fractionally. This configuration is self-reciprocal. The properties of this configuration and of other allied configurations similarly related to certain important subgroups of the main group are developed. Professor Moore's paper will appear in the *Bulletin of the American Mathematical Society.* It was presented at the meeting by the Secretary.

Professor Baker's paper contained a detailed discussion of the character of the operations of algebra and the theory of imaginary quantities. It will be published in the *American Journal of Mathematics.*

In Professor Van Vleck's paper an aggregate of regular linear differential equations of the second order is taken, each of which has a polynomial solution. The requirement is made that these equations shall have a common group arising from their four common branch points; in Riemann's phraseology, that they shall be related. This requirement necessitates the introduction of one accessory branch point into each equation. These accessory points do not, however, give rise to any substitutions of the group. The paper outlines a method by which the position of the accessory points may be investigated, as well as the distribution of the roots of the various polynomials between the four (real) branch points and in the imaginary domain. One result is the determination of the distribution of the roots of all polynomials satisfying differential equations of the second order with exactly four branch points which with their exponent differences are given.

Mr. Roberts' paper gives the differential equations of certain systems of conics in a

plane, viz., conics having double contact with two fixed conics, etc., and in space, of conics touching six fixed planes, conics having double contact with three quadrics inscribed in the same developable, circles having double contact with two confocal quadrics, etc. These results are principally deduced by means of elliptic integrals and the first-class of hyper-elliptic integrals, and from them flow certain theorems concerning doubly infinite porisms of curvilinear polygons. This paper will be published in the *Bulletin of the American Mathematical Society.*

Professor Taber's paper related to the orthogonal transformations which leave a bilinear form unaltered, and their generation by means of infinitesimal transformations. It has been contributed to the *Quarterly Journal of Pure and Applied Mathematics.*

In Professor Hathaway's paper the proof consists in identifying, by means of elementary geometry, the product of several versors with the composition of a set of rotations through angles double those of the corresponding versors. The obvious associative principle of the composition of the rotations proves the corresponding associative principle of multiplication of versors. This paper will appear in the *Bulletin of the American Mathematical Society.* It was presented to the Society by Professor Shaw.

Professor Maschke's paper contains a very elegant application of elliptic functions to curves drawn on the surface of a circular ring. This paper will also appear in the *Bulletin of the American Mathematical Society.* It was presented to the Society by Professor Morley.

At the afternoon session, August 28th, two topics were presented to the Society for general discussion:

(1) 'A general subject catalogue or index of mathematical literature.'

(2) 'The mathematical curriculum of the college and scientific school.'

The first discussion was opened by the Secretary, who gave a brief account of the '*Répertoire bibliographique des sciences mathématiques*,' in course of publication by the Mathematical Society of France. The discussion was continued by Professors Morley, Woodward and McMahon. On motion by Professor McMahon, it was resolved that the Council be requested to consider the desirability of offering to the Mathematical Society of France the coöperation of this Society and of drawing up a plan for such coöperation.

The second discussion was opened by Professor Shaw, who presented a table of statistics showing the character of the mathematical instruction in 101 representative colleges and scientific schools. The discussion was continued by Professors White, Morley, Van Vleck, Doolittle, Chandler, Pupin and Woodward. It seemed to be generally held that the work of the preparatory schools as a whole is not sufficiently thorough to serve as a satisfactory basis for collegiate courses; that a greater proportion of the students' time should be given to mathematical study; that greater stress should be laid on the fundamental subjects; that elementary portions of applied mathematics should be earlier introduced and more extensively taught, and that spherical trigonometry should be in great part, or altogether, dropped from the required curriculum.

At the close of the discussion the thanks of the Society were tendered to the Springfield Local Committee for the accommodations and hospitality which the Society had enjoyed, and the meeting was adjourned.

THOMAS S. FISKE.

COLUMBIA COLLEGE.

THE SPRINGFIELD MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION A. MATHEMATICS AND ASTRONOMY.

IN section A, Mathematics and Astronomy, the following papers were read :

1. *Development of Some Useful Quaternion Expressions, with Applications to Geometry of Three and Four Dimensions:* JAMES BYRNIE SHAW.
2. *The Constant of Aberration:* C. L. DOOLITTLE.
3. *On the Constant of Nutation:* S. C. CHANDLER.
4. *Progress of the Zone Work at the Naval Observatory, Washington:* A. N. SKINNER.
5. *On the Distribution and the Secular Variation of Terrestrial Magnetism* (read by title): L. A. BAUER.
6. *Sun Spots and Magnetic Storms:* M. A. VEEDER.
7. *The Spectrum of B. Lyræ:* EDWIN B. FROST.
8. *Notes on Square Numbers Whose Sum Is Either a Square or the Sum of Other Squares:* ARTEMAS MARTIN.
9. *Some Results for Stellar Parallax from Meridian Transit Observations at the Washburn Observatory:* ALBERT S. FLINT.
10. *A Convenient Formula for Computing Times of Moon Rising:* EDGAR FRISBY.
11. *On a Slide Scale for Computing Precession:* EDGAR FRISBY.
12. *Chronology and Ancient Eclipses:* SAMUEL W. BALCH.
13. *Period of R. Comæ:* HENRY PARKHURST.

In his paper Professor Shaw develops the alternating functions, $A.pq = \frac{1}{2}(pq - qp$,

$$S.\ p\ Aqr$$
$$A.\ pqr = S.\ p\ Aqr - Sp.\ A.\ qr,$$
$$- Sq.\ Arp - Sr.\ Apr,$$
$$S.\ p\ Aqrs.$$

A set of four quaternions related to one another is deduced, analogous to a set of three rectangular unit vectors and from which various collections of formulas can be derived.

Affixing one of the set of four quaternions to each vertex of a tetrahedron and letting the point $P = x_1 l_1 + x_2 l_2 + x_3 l_3 + x_4 l_4$ be that point for which the volumes BC, P — BCD, P — CDA, P — DAB, P — ABC are as $x_1 : x_2 : x_3 : x_4$ we are enabled to treat solid geometry projectively.

The elaborate and carefully arranged series of observations made by Professor C. L. Doolittle at Lehigh University, primarily for the determination of the variation of latitude, was planned by him so that a determination of the constant of aberration could also be secured, stars being taken throughout all the 24 hours, and the pairs being observed before and after midnight so as to obtain maximum aberration coefficients, with opposite sign. This series was observed from 1892, October 10, to 1893, December 27, 442 nights.

Professor Doolittle finds for the constant of aberration

$$20.''55,$$

Struve's value being 20.″44. Later values differ considerably from that of Struve, and it would appear that his value is too small.

Dr. Chandler, on examining Pond's Greenwich mural circle observations with the idea of getting at the long period term of the variation of latitude, found the work to be of excellent quality, quite as good as the modern work, though imperfectly reduced. The plan of observation was first-rate, being so arranged as to eliminate as far as possible division errors, flexure and all instrumental constants. Indeed, Dr. Chandler regards the discovery of the good quality of this work as a most important one. From Pond's observations is found for the constant of lunar nutation

$$9.''190,$$

the usual value, called Peters', being

$$9.''223.$$

Peters observed only a few stars and took no account of the long period variation of latitude. It is probable that the constant of lunar nutation is very nearly

$$9.''20,$$

since Professor Newcomb finds for this constant from the Greenwich transit circle declinations and the Washington transit circle declinations respectively

$$9.''194,$$
$$9.''204.$$

It should be noted that Dr. Chandler's discussion of Pond's mural circle declinations confirms Boss' proper motions as being almost exact.

A number of years ago the German Astronomical Society inaugurated the plan of making fairly accurate determinations of the stars in the Durchmusterung of Argelandler and that of Schönfeld. The sky was divided into bands or zones, every zone overlapping for comparsion purposes on the zones north and south.

Mr. Skinner gave an account of the work on the zone — 13° 50′ to — 18° 10′ which had been assigned to the Naval Observatory, and which is now being observed there under his charge. Zero stars are distributed throughout the zone, the other stars being determined differentially with respect to them. Each star is to be determined at least twice. The work has now been going on for a year and a half. The zone has been observed in one position of the instrument, and 5,714 stars in the reversed position, the whole numbor of stars being more than 8,000. Probably the observing will be completed next winter and it will be about two years after that before the reductions are finished.

Dr. Veeder is doing excellent work collecting statistics with regard to auroras, magnetic storms and thunder storms, and endeavoring to derive general laws. It is to be hoped that many observers may be found who will furnish him the data he desires.

The problems regarding the spectrum of β Lyræ as brought to light by recent spectroscopic observations of this star at Pulkova, Potsdam and London were treated by Professor Frost.

Mr. A. S. Flint, of the Washburn observatory, presented some results of the researches with regard to stellar parallax undertaken by him with the Repsold meridian circle of that observatory by the method of Kapteyn. A list was made of stars having a proper motion of 1″ or more. A large number of these stars Mr. Flint has observed for three epochs, and he proposes to continue until he shall secure five. As to the method of observing a bright field was used and wire screens were employed so that all stars should appear in the telescope as approximately of the same brightness. The observations were begun 1893, October. The method of Kapteyn, which is differential, employing a preceding and following comparison star, is certainly excellent. Mr. Flint has obtained important results of a high order of accuracy.

ASAPH HALL, JR.

SECTION E. GEOLOGY AND GEOGRAPHY.

EIGHTEEN papers were presented to the section this year, but only thirteen were read in full, as the authors of the others were not present at the meeting. Major Jed. Hotchkiss, of Staunton, Va., the Vice-President, was absent from the early sessions of the section, so that his address was not delivered until Monday afternoon. He then gave a somewhat informal talk on the geological survey of Virginia, 1835–1841, and its influence on the history of science in this country. This survey was conducted by Professors W. B. and H. D. Rogers and was held by the speaker to have been the first important geological survey carried on in the United States. The work was carried on for five years at an expense of only $100,000 and the results lie at the foundation of the progress made in geology since.

'The relations of primary and secondary structures in rocks' was the topic discussed by Professor C. R. Van Hise, of Madison, Wis. The paper inquired into the relations of cleavage and fissility to bedding, and showed that in homogeneous rocks the law of hydrostatic viscous flow applies, and therefore that the secondary structure cuts the primary. In heterogeneous rocks the beds are of varying strength, and the accommodations between them control the major movements, which are parallel to them. The secondary structure is produced

by shearing and is therefore parallel to the bedding, and this may be called parallel cleavage or parallel fissility. In heterogeneous rocks, however, at the crests and troughs the law of hydrostatic flow chiefly applies, while the law of shearing applies at the limbs. In passing from the limbs of the folds to the arches and troughs the two tendencies are both at work, and the phenomena are the resultants of both forces. The law of hydrostatic viscous flow becomes predominant as the arch or trough is neared; the law of shearing, as the limb is approached.

Professor B. K. Emerson, Amherst, Mass., delivered the substance of two papers on the Archæan and Cambrian rocks of the Green Mountain range in southern Massachusetts and on the geology of Worcester County, Mass., which embodied a preliminary account of the author's work on the region for the United States Geological Survey. The Green Mountains traverse western Massachusetts in a series of complex anticlines and synclines which are partly overturned and overthrust westward. Upon these in places there is unconformable conglomerate gneiss of Cambrian age. The author illustrated by means of the United States Geological Survey topographic maps the progress of the work in mapping the intricate crystalline rocks in the district.

'Gotham's Cave, or Fractured Rocks in Northern Vermont' was the title of a short paper by Professor C. H. Hitchcock, N. H., describing with the aid of sketch maps and sections a peculiar occurrence in the Green Mountain State.

'Recent discovery of the occurrence of marine cretaceous strata on Long Island.' In this paper Mr. Arthur Hollick, of Columbia College, said that the presence on Long Island of cretaceous strata belonging to the so-called non-marine division was amply demonstrated some years ago, but until the past year the evidence of the existence there of marine strata of this age was confined almost entirely to the alleged discovery of an *Exogyra* in an excavation for a well in Brooklyn. Last summer, while examining the north shore at Center Island, evidences of more strata were observed, and afterwards hardened fragments of marl containing *Gryphæa* and other cretaceous molluscs were found in the moraine near Ridgewood Reservoir, Brooklyn.

Dr. J. W. Spencer read a contribution on the 'Geological Canals between the Atlantic and Pacific Oceans.' He said that over the Isthmus of Tehuantepec, in Mexico, low planes now eroded mark a shallow strait of a few miles in width connecting the basin of the Mexican Gulf with that of the Pacific Ocean. This land is now raised about 1,000 feet above sea level. Through these straits there are two lower canals about 800 feet above tide, only a mile long and a quarter of a mile wide, whose floors are covered with gravels which are continuous with terraces upon the gulf side. The time of elevation is that of the recent terrace epoch; at any rate it was later than the Columbia period.

A second paper by Dr. Spencer dealt with the 'Recent Elevation of New England.' He holds that the high terraces in the valleys of New England are not those of rivers but of estuaries. These terraces occur on the north, east, south and west sides of the New England rivers from an elevation of at least 2,700 feet downward by level steps. From their features it is inferred that these steps represent changes in the base plane of erosion, or, in other words, successive uplifts in the most recent post-glacial times in amount approximately equal to the aggregate heights of the terraces. The elevation appears to have been greater in the mountain masses than nearer the sea.

'Geological Notes on the Isles of Shoals,' by Dr. H. C. Hovey, Newburyport, Mass. The author briefly described these islands,

which lie off the coast of Maine and New Hampshire. Statements made by reliable residents seem to show that some of the islands have risen six feet in the last fifty years, while the rest seem to be stationary. The general rock is gneissoid to schistose and varies in color from white to black. The islands are traversed by numerous dykes of basic rock. On Appledore Island there is a peculiar six-sided column of granitoid rock protruding through a schistose, biotite gneiss. The column is more than eleven feet in diameter and its original height must have been from 25 to 50 feet.

'The Great Falls of the Mohawk at Cohoes, N. Y.,' by W. H. C. Pynchon, Trinity College, Hartford, Conn. This paper described, by the aid of maps and stereopticon views, the gorge of the Mohawk and the falls. The author brought out the fact that the rocks, which are Hudson river shales, dip sharply down stream instead of up stream as is the case at many falls, notably Niagara. The gorge is shown to be a post-glacial cutting and the old valley still exists not far from the present one. The position of the strata facilitates the formation of innumerable pot holes of all sizes up to ten feet in diameter.

In a paper entitled 'Subdivisions of the Upper Silurian in Northeastern Iowa,' A. G. Wilson, of Hopkinton, Ia., gave lithological and palæontological characteristics on which he would propose to divide the Niagara strata there into five groups:

5. The building stone.
4. The upper coralline beds.
3. The Pentamerus beds.
2. The lower coralline beds.
1. The beds of passage from the Maquoketa shales.

Professor J. P. Smith, Stanford University, California, in a paper on the metamorphic series of the Shasta region of California, supplemented observations which the author detailed to the section at the Brooklyn meeting. New finds in the Middle Trias shales make the age assigned to them more probable; certain strata which are of Upper Trias combine in the same beds fossils which are always in separate beds in the Alps and Himalayas. The discovery of an upper Karnic, or more probably Jurassic, fauna was announced.

In the absence of the author, Mr. Warren Upham's paper on a 'View of the Ice Age as Two Epochs, the Glacial and the Champlain,' was read in abstract at the request of some members of the section. The author divides the Glacial epoch of ice accumulation into four stages: 1, Culmination of the Lafayette epeirogenic uplift; 2, the Kansan stage, marking the farthest extent of the ice sheet; 3, the Helvetian or Aftonian stage, during which there was considerable recession of the ice-front; 4, the Iowan stage of renewed ice accumulation. The Champlain epoch of ice departure is divided into four more stages continuing the others: 5, the Champlain subsidence or Neudeckian stage—a time of widespread depression; 6, the Wisconsin stage—marked by moderate re-elevation of the land; 7, the Warren stage, of maximum extent of glacial Lake Warren, and 8, the Toronto stage, with slight glacial oscillations, but temperate climate at Toronto and Scarboro,' Ontario.

'A re-survey of the whirlpool and vicinity of the Niagara river, with a demonstration of the true geology of the locality, illustrated by a new, large map.' In this paper Mr. George W. Holley presented some views regarding the origin and history of the gorge of the Niagara which were considerably at variance with those commonly accepted by geologists.

'Glacial phenomena between Lake Champlain, Lake George and the Hudson' was the title of a paper by Professor G. F. Wright, of Oberlin, Ohio, in which the author detailed the results of recent personal study of that region. He described the mo-

rainic lakes which existed at two or three points along the southern shore of Lake George and the end of Lake Champlain, the drainage of Lake George in both directions after the ice had left its basin, and the elevated gravel and sand terrace near Saratoga.

In a somewhat informal lecture Professor H. L. Fairchild, Rochester, N. Y., described some interesting features in the surface geology of the Genesee region, New York. The lecture was illustrated by numerous lantern slides, some of which were especially instructive as showing in an excellent manner the intimate structure of the gravel and sand beds. These are glacial till as well as stratified lacustrine deposits.

The papers read only by title were:

Terminology proposed for the description of the shell in Pelecypoda: by Professor A. Hyatt, Boston, Mass.

Russia in Europe: by Dr. Gardiner G. Hubbard, Washington, D. C.

Distribution of sharks in the Cretaceous: by C. R. Eastman, Cambridge, Mass.

The equatorial counter currents: by Professor W. M. Davis, Cambridge, Mass.

On Saturday, 31st August, the section joined in the general excursion to Amherst, Northampton and South Hadley. The interest for the section centered in Amherst, of course, and there, under the guidance of Professor B. K. Emerson, the members studied the famous collection of footprints and other impressions from the Connecticut trias made by President E. Hitchcock. These remain in the Appleton Cabinet just as they were left by President Hitchcock. In another building are the fine collections of minerals and rocks which have been gotten together by Professor Emerson since the fire occurred which destroyed the College collections some years ago.

Tuesday nine or ten members of the section availed themselves of the opportunity offered to accompany Professor W. M. Davis to the region of trap and sandstone near Meriden, Conn., which he has studied so thoroughly, from which he has described overflow sheets of trap, beds of tuff with ejected blocks and extensive faults.

Edmund Otis Hovey.

SECTION G. BOTANY.

The botanists were well represented at the recent meeting of the American Association for the Advancement of Science, held at Springfield, Mass. Interesting papers were presented at the meetings of the Botanical Society of America and the Botanical Club. In addition to these Affiliated Societies, Section G (Botany), of the Association proper, also had a full program.

The address of the Vice-President, Dr. J. C. Arthur, was delivered on Thursday afternoon, August 29, the subject being 'The Progress of Vegetable Physiology.' As the address appeared in full in Science, September 20th, it is not necessary to review it here. The papers read before Section G are briefly reviewed below:

1. *A Leaf Rot of Cabbage*, by H. L. Russell, Madison, Wis. In the absence of the author this paper was read by Professor Barnes, of the University of Wisconsin. The disease seems to be associated with bacteria, although the author has not succeeded in isolating the organism. The axils of the lower leaves first show the disease. These points are usually filled with moisture, and the disease gains an entrance through rents caused by rapid growth of the tissue. Once within the tissues, the disease spreads rapidly through the fibro-vascular bundles; as a result, the functions of the plant are disturbed and the leaves wilt. The disease seems to be different from the one described by Garman, and may be checked by cutting off the affected leaves along the main stalk.

2. *Watermelon Wilt and other Wilt Dis-*

eases Due to Fusarium, by ERWIN F. SMITH, Washington, D. C. The author reviewed the work of last year and gave the results of investigations confirming previous statements regarding the nature and cause of watermelon wilt. The discovery of two additional stages of the wilt fungus were noted, and evidence was brought forward to show the great vitality of the fungus. Wilt diseases caused by *Fusarium* have been recently found in a number of other plants, notably sweet potato, cabbage, and cowpeas. On the last-mentioned plant a new *Nectriella* was found, and the evidence shows that the conidia so abundant outside and inside of the plant are but forms of this Ascomycete.

3. *Observations on the Development of Uncinula spiralis* B. & C., by B. T. Galloway, Washington, D. C. The author first called attention to a paper presented before the Association in 1890, in which it was shown by artificial cultures that the forms of *Uncinula spiralis* found on Vitis and Ampelopsis are identical. The development of the fungus was then discussed, especial attention being called to the manner in which the parasite passes the winter. It was shown that the first material change in the fungus after the leaves have fallen is the disappearance of the perithecial appendages. Observations made from time to time brought out the fact that there was no germination of ascospores before January. Through the months of January and February the ascospores were successfully germinated by keeping perithecia, which had been out all winter, for several weeks in moist chambers. The asci were ejected from the perithecia with considerable force, and in most cases collapsed as soon as free. Only a comparatively small number of asci and ascospores remained perfect, and such of the latter as did not break up commenced to germinate within four or five hours after their escape from the ascus. Attempts were made to obtain the fungus on Vitis and Ampelopsis by sowing ascospores, but this work was wholly negative.

4. *The Effect of Sudden Changes of Turgor and of Temperature on Growth*, by RODNEY H. TRUE, Madison, Wis. In the absence of the author, this paper also was read by Prof. Barnes. The author claims that growth and turgor pressure have no direct proportional relation, and in proof of this shows the variation in growth when a radicle is suddenly transferred from water to a one per cent. solution of KNO_3 or *vice versa*, or when it is accommodated to these media by a stay of two or three days before the transfer is made. He attributes retardation to the irritable qualities of the plant, and in substantiation of this discusses the fact that when change of medium produces a very material increase of turgor pressure the rate of growth usual for both media mentioned falls below the normal. He found changes of temperature to affect growth in about the same way as changes of turgor, the retardation period in this case depending upon length of time between extremes and length of time spent at the lower limit when the plant is transferred to a normal range. The author's conclusion is that sudden changes in turgor pressure or surrounding temperature act as a shock to the irritable organisms and cause a pronounced retardation of growth.

5. *Recording Apparatus for the Study of Transpiration of Plants*, by ALBERT F. WOODS, Washington, D. C. Attention was first called by the author to the fact that the direct method of weighing the plant is the most satisfactory one of determining the amount of water evaporated during a given period. Various automatic devices for accomplishing this object have been described and used. The apparatus in question is a modification of Marvin's recording rain and snow gauge, and is designed to register automatically the loss of water through any given period. It is constructed so as to

register a tenth of a gram. This amount can be reduced to smaller quantities by subdividing the curve recorded.

6. *Pressure, Normal Work, and Surplus Energy in Growing Plants*, by George M. Holferty, Leipzig, Germany. This paper was read by Professor Barnes in the absence of the author. The general questions of pressure, interior and exterior; resistance, natural and artificial; work effects, normal and extra, were discussed. Pfeffer's results showing the amount of pressure were given, and the gypsum method and pressure spring for root pressure were described.

7. *Notes on the Ninth Edition of the London Catalogue of British Plants*, by N. L. Britton, Columbia College, New York City. The author gave a comparison of the treatment and nomenclature of genera in the catalogue common to Great Britain and northeastern North America.

8. *Obolaria virginica L., a Morphological and Anatomical Study*, by Theodore Holm, Washington, D. C. The systematic position of *Obolaria virginica* L. was reviewed, the statements being based upon the morphological characteristics and the anatomy of the various organs of the plant.

9. *Botany of Yakutat Bay, Alaska*, by Frederick V. Coville, Washington, D. C. This paper was a review of a report upon a collection of plants made at Yakutat Bay, Alaska, by Mr. Frederick Funston in 1892. Attention was called to the more important plants collected and a general account was given of the relation of the plant life of the region to environmental conditions and native industries.

The foregoing papers completed the program for Friday. Saturday being devoted to general excursions no regular meetings were held. On Monday Section F (Zoölogy) and Section G (Botany) met in joint session with the following program:

10. *Fungous Gardens in the Nest of an Ant (Atta tardigrada Buckl.) near Washington, D. C.*, by W. T. Swingle, Washington, D. C. The author first briefly reviewed the published statements by Belt made in 1874, that the Central American leaf-cutting ants use the cut-up leaves for carrying into their nests as a medium upon which to grow fungi which serve as food for the ants. The important work of Möller on the fungous gardens of ants in south Brazil, published in 1893, was then reviewed. Möller showed that the ants not only cultivate a fungus on chewed-up fragments of leaves, but that they also make pure cultures of a single species, and furthermore, that they prevent the fungus from producing conidia or other reproductive bodies. The fungus under the action of the ants gives rise to globular inflated hypha ends, which are incapable of germinating and which Möller designated as kohlrabis. In July of this year the author examined some colonies of *Atta tardigrada* in the vicinity of Washington, and found within the nests a fungus closely resembling that described by Möller. Kohlrabis even larger and more perfect than those described by Möller were found, and from this and other evidence the author thinks that it is by no means improbable that the species will prove to be the same as that described by Möller.

11. *Distinction between Animals and Plants*, by J. C. Arthur, La Fayette, Ind. The author called attention to the present and former use of physiological characters to distinguish plants and animals, and to the insufficiency of such characters to explain the differences under consideration. The following was suggested as expressing the difference between animals and plants: "Plants are organisms possessing in their vegetative state a cellulose investment; animals are organisms possessing in their vegetative state a proteid investment, actual or potential."

12. *Variation after Birth*, by L. H. Bailey, Ithaca, New York. The author

reviewed the current discussion of causes of variation and showed that they are concerned chiefly with those forms which are congenital. Argument was then advanced to show that a given set of individuals starting equal may arrive at very unlike destinies. These dissimilarities may be impressed upon the offspring.

13. *Rejuvenation and Heredity*, by CHAS. S. MINOT. The author traced the rôle of the embryonic type of cells in animals and plants as a necessary predisposition of structure for the action of heredity. The rôle of the embryonic type of cells in both animals and plants in reproduction and regeneration was discussed for the purpose of showing that their functions render it impossible to accept Weissman's theory of heredity.

At the close of the last paper the joint session ended. On the afternoon of Monday the final papers before Section G were presented. These are given below:

14. *Poisoning by Broad-leaved Laurel (Kalmia latifolia)*, by FREDERICK V. COVILLE, Washington, D. C. Read by title.

15. *The Number of Spore Mother Cells in the Sporangia of Ferns*, by WILLIS L. JEPSON, Berkeley, Cal. This paper was presented by Prof. Geo. F. Atkinson, and gave the details of investigations to determine the number of spore mother cells in the sporangia of *Pteris crethea*, with comparisons of other species of *Pteridophyta*.

16. *The Southern Tomato Blight*, by ERWIN F. SMITH, Washington, D. C. The author reviewed his previous work on this subject, and from the evidence obtained concludes that the tomato wilt and cucumber wilt are not identical; that the tomato and potato wilt are identical; that various other solanaceous plants, including eggplant, are susceptible to the disease; that the cause of the disease, as determined by inoculations, is a bacillus, the biology of which has not been fully worked out; that the stinking wet rot is due apparently to one or more organisms which follow in the path of the true parasite; and finally, that primary infection of the plants as a rule takes place through the parts above ground.

17. *Constancy of the Bacterial Flora of Fore Milk*, by H. L. BOLLEY, Fargo, N. Dak. This paper was a report of investigations on the constancy of species and physiological types of bacteria in normal fore milk. The experiment was conducted with ten animals during three winter months and three animals during the month of July. The conclusion drawn by the author is that species may be quite constant in the udder of an individual animal, but that there is little evidence of constancy among different animals, even under similar conditions.

18. *A New California Liverwort*, by DOUGLAS H. CAMPBELL, Palo Alto, Cal. The author gave a brief account of a new liverwort allied to *Sphærocarpus*, collected near San Diego, Cal.

19. *Personal Nomenclature in the Myxomycetes*, by O. F. COOK, Huntington, N. Y. The author claims that only the personal system of nomenclature is used in the Myxomycetes, naming Massee's Myxogastres and Lister's Mycetozoa in substantiation of the claim. The paper discusses the author's view of the changes which will be necessary should the priority system of nomenclature be adopted.

20. *Root Fungus of Maize: Enantiomorphism in Plants*, by GEO. MACLOSKIE, Princeton, N. J. The root cap of the roots of maize is described. The author believes that the nature of the cap makes it a medium for the luxuriant growth of a certain microscopic fungus, and that this fungus may possibly account for the ability of Gramineæ to extract nitrogenous food without impoverishing the soil. The author claims to have discovered two kinds of maize produced from the same ear, and states that this diversity depends on place of origin of

the ovules. This habit the author calls antidromy, and claims that all flowering plants are antidromous. The manner in which this habit manifests itself in different plants is described and a list of the plants examined is given. The author thinks this law will explain many of the mysteries of plant growth.

21. *Exoascus upon Alnus Leaves*, by Mrs. Flora W. Patterson, Cambridge, Mass. An account is given of the first recorded appearance of Exoascus on Alnus leaves in America. The difference between this Exoascus and various other species is shown. The species will not be named until additional knowledge in regard to it is obtained.

22. *Experiments in Pollinating and Hybridizing Citrus Fruits*, by H. J. Webber, Eustis, Fla. The author gives an account of his experiments to determine the cause of the sterility of the Navel orange. It was found that this variety produces no pollen. The form, growth, etc., of the Navel and common oranges are minutely described. Experiments were also conducted by the author to determine if Navel oranges develop without pollination and the effect on this variety of foreign pollen. Other experiments in hybridizing were also described.

23. *Summary of a Revision of the Genus Dicranum*, by Chas. R. Barnes and Rodney H. True, Madison, Wis. Read by title.

24. *The Physiology of Isopyrum viternatum L., and the Transmission of Stimuli Effects in Mimosa pudica L.*, by D. T. MacDougal, University of Minnesota. The papers by Professor MacDougal were read during the absence of the Secretary, and as the abstracts were not at hand a review cannot be given.

On Saturday, August 30, a number of the botanists visited Harvard College, where they were entertained by Dr. Farlow, and shown the many things of botanical interest in the vicinity of Cambridge.

B. T. Galloway, *Secretary*.

SECTION I. ECONOMICS.

The most important feature of the meeting was the change in name of the section, looking toward an extension of scope. The old name 'Economic Science and Statistics' was justly regarded as bungling and inadequate. The question of terminology is, however, a serious one. No name wholly adequate to express and limit the field which this section seeks to cover could be found. It is properly a branch or offshot of anthropology, as Mr. Fernow showed in his Vice-Presidential address, and is concerned with all that advances the physical well-being of man; while, equally with anthropology, it discusses his social and moral welfare, all being indissolubly knit together. 'Sociology' was at first the name selected by the section, after considering 'Social and Economic Science.' The general session, however, preferred the latter, and the constitution was accordingly so amended.

The Section of 'Social and Economic Science' is fortunate in having had as its President this year an economist so well and favorably known as B. E. Fernow, Chief of the Division of Forestry; and equally fortunate in the election for next year of Wm. R. Lazenby, so long a professor at the Agricultural College at Columbus, O., and this year doubly honored by election to the office of President of the Society for the Promotion of Agricultural Science.

Popular interest in this section is always great, and even when there is not a flood of papers there are always some to arrest attention. Not that everything said in the section is sound. Some wild monetary theories have been broached; some revolutionary socialistic schemes advocated, but the sound common sense of the majority of members gives them a speedy quietus, and the result is better than if they were exploited somewhere else where their fallacy might be less promptly refuted. On the other hand, some interesting and valuable

material is almost certain to be presented among the papers read and in the discussions.

Papers were read by title in the section on 'The Law of Chance Illustrated in Railway Accidents,' by T. C. Mendenhall, and on 'Suicide,' by W. L. O'Neill. On the morning of Friday, August 30, Mr. Henry Farquhar read a paper on 'An International Coinage,' which contained arguments for such a system and reviewed the difficulties to be overcome before the system could be put in practical operation.

In the afternoon a joint session of Sections A, B, E and I was held to listen to papers on meteorology, which will be reported elsewhere in this journal.

On Monday, September 2, the first paper presented was by the Secretary of the Section, W. R. Lazenby, whose subject was 'Manual Training in Horticulture for Our Country Schools.' The author said that in the earlier educational history of this country, when the forests covered large sections of the land and people lived in log houses built by their own hands, and the schoolhouses were constructed in the same manner, the boys and girls grew to be men and women of great force of character and strong personality. Nothing could be more useful than manual training in horticulture to train the eye and hand, to stimulate the power of observation, to awaken an appreciation of the beautiful, in short to develop all the faculties of body and mind, which is the aim of modern education. In a paper entitled, 'Equality of Opportunity—How Can We Secure It?' J. L. Cowles argued in favor of government control of the means of communication and transportation. Mrs. Mary J. Eastman, an associate member, was invited to read a paper on 'A Cottage Settlement in Spain,' in which she advocated the extension of the university settlement idea by the establishment of model cottages.

On Tuesday, September 3, E. L. Corthell read a paper on 'The Growth of Great Cities.' He traced the growth of cities, and closed by predicting the population of some of the world's greatest cities in 1920, as based on past and present growth, and allowing for a future decrease. His predictions are as follows: Population of London 8,344,000; Paris, 3,808,586; New York, 6,337,500; Berlin, 3,422,221; Chicago, 7,797,600; Philadelphia, 1,838,160; St. Petersburg, 1,470,833. The last paper of the meeting was on 'Taxation in the United States,' by Edward Atkinson. The speaker aimed to show the necessity of carefully investigating what proportion of taxes goes to construction, to interest, etc. Other things being equal, the country that spends the most of its taxes for construction and the least for military expenses is the best administered.

SCIENTIFIC NOTES AND NEWS.

M. CH. BOUCHARD announced to the Paris Academy of Sciences, on September 2d, that he had examined the gases from three sulphurous springs in the Pryenees. In one he found the characteristic lines of both argon and helium, in one of helium alone, and in a third helium together with an unknown substance characterized by lines in the orange and red.

AT the same meeting of the Academy, M. J. Janssen reported on the work at Mont Blanc Observatory. Measurements of the force of gravity have been made at Chamonix and at the Grand-Mulets, at an elevation of 3,050 m., and it is hoped to repeat the measurements next year at the summit, if it be found possible to transport the apparatus. M. de Thierry has ascended to the summit in order to study the ozone in the air and make certain bacteriological examinations.

PROFESSOR C. V. RILEY, the entomologist, was killed by a fall from a bicycle at Wash-

ington on September 14th. We hope to give an account of Professor Riley's scientific work in an early number of this journal.

Professor E. D. Cope's important work, previously announced in this journal, will be published in October by the Open Court Publishing Company. It will be entitled *The Primary Factors of Organic Evolution.* The same publishers announce *Post-Darwinian Questions*, the second part of the late Prof. George J. Romanes's work *Darwin, and After Darwin.* With the exception of the concluding chapters, the present volume was ready for publication over two years ago, but the severe and protracted illness of Professor Romanes prevented its speedy completion. On his death, in 1894, the manuscript was placed in the hands of his friend, Prof. C. Lloyd Morgan, Principal of University College, Bristol, England, who has edited the work.

The autobiography of Mr. Herbert Spencer is already in print, though it will not be issued till after his death.

The Naturforschende Gesellschaft of Switzerland met at Zermatt from September 8th to 11th, and The Swiss Geographical Societies at St. Gall on September 22d and 23d.

Nature states that a memorial tablet in honor of v. Helmholtz has been affixed to the house No. 8 Haditz Strasse, Potsdam, in which he was born, and also that it is intended to erect a joint monument to the memory of Werner Siemens and v. Helmholtz in front of the Technische Hochschule at Charlottenberg.

We have received No. 62 of the *Monthly Weather Review*, containing the annual summary for 1894. Tables and charts are given showing barometer readings, temperature, precipitation and other meteorological phenomena throughout the United States.

The English record in railway speed made by a run from London to Aberdeen over the London & Northwestern Railway of 540 miles in 512 minutes has been surpassed by a run on the New York Central & Hudson River Railroad on September 11th. The train ran from New York to Buffalo, a distance of 436½ miles in 407 minutes. This is an average of 64⅕ miles an hour as compared with the English record of 63½ miles an hour. The train on the New York Central & Hudson River Railroad was also much the heavier.

At a recent meeting of the Park Board, New York, eight bids ranging from $319,000 to $444,000 were received from various builders and contractors for the completion and enlargement of the new west wing of the American Museum of Natural History. The awards will probably be made in a few days.

The *British Medical Journal* states that a quarterly court of the governors of the London Hospital was held on September 4th, Mr. J. H. Buxton, the Treasurer, presiding. In the report the House Committee stated that the amount subscribed to the Sir Andrew Clark Memorial Fund was close upon £3,000, and it had been determined to recommend the governors to adopt a scheme for the building of a female erysipelas ward and accommodation for cases needing isolation, and additional rooms for the porters. To carry that scheme into effect a further expenditure of £1,500 would be necessary, and the Board asked the governors to sanction that step.

The Prince of Wales has accepted the presidency of the committee of the Huxley Memorial. The general committee will probably hold its first meeting some time in October.

The Orient Steam Navigation Company, Ltd., propose to send one of their steamships of about 4,000 tons gross register and 3,000 H.P. to Vadsö in the Varanger Fiord,

Lapland (about 30° E. Long.), to enable observation to be made of the total eclipse of the sun on August 9th, 1896. The steamship starts on July 21st and is due at London on the return voyage on August 17th. The passage money is forty guineas.

IT is stated that 2,000 deaths from cholera are occuring daily in Pekin. Cholera is also raging in the Russian Government of Volhynia, where the deaths are said to be about 250 a day.

ACCORDING to the *Naturwissenschaftliche Rundschau* Prof. Ernst Beyrich of Berlin has been presented with the gold 'Cothenius Medaille' by the Leopoldinisch-Carolinische deutsche Akademie der Naturforscher.

WALTER SCOTT has published *The Growth of the Brain*, by Prof. H. H. Donaldson, of the University of Chicago, as the latest volume of the Contemporary Science Series. The work will doubtless be shortly published in America by Chas. Scribner's Sons.

AN international industrial exhibition will be held at Cape Town, under the auspices of the Chamber of Commerce. The exhibition will open on November 18th and will continue for six weeks.

GINN & Co. announce a text-book on the *Elements of Plant Anatomy*, by Emily L. Gregory, of Barnard College. The book is divided into two parts, the plant cell and cell aggregates or tissues.

ACCORDING to the report of the Chief of the U. S. Weather Bureau for 1893 the total number of deaths in the United States caused by violent winds was 399, and the number of deaths caused by lightning was 209. In 1892 the deaths caused by violent wind and lightning were nearly the same, 252 and 251 respectively.

THE meeting of the German Association for the Repression of the Abuse of Alcoholic Drinks will be held this year at Munich on September 18th and 19th. Among the papers to be presented are 'Hygiene and Temperance' by Professors Hans Buchner and Max von Pettenkofer; and 'Beer and the Alcohol Question' by Professor Moritz, of Munich.

ACCORDING to the London *Times* 320 cases of small-pox were under treatment within the metropolitan area on September 12th.

THE International Congress of Physiology opened at Berne on September 9th. Some 80 papers were on the program.

MR. H. TWEDDELL, a distinguished English engineer, died on August 23d.

M. JULES LAVERRIÈRE, a French writer on agriculture, died at Lyons at the beginning of the present month.

A TELEGRAM has been received from India by the relatives of Mr. Mummery, the famous Alpine climber, stating that he has been lost while climbing the Himalayas, and that his remains are being searched for.

THE deaths are reported on August 26th of Dr. Frederick Miescher and Dr. Ernst de Sury, professors of physiology and of legal medicine, respectively at Bâle, and of Dr. Moritz Willkomm, professor of botany in the German University at Prague.

UNIVERSITY AND EDUCATIONAL NEWS.

THE faculty of Harvard University has sent to the corporation a proposition to establish 'docents' similar to those in the German universities. The men thus designated would be holders of the degree of Ph. D. who might offer advanced courses to graduate students without being paid for their work by the University.

MR. MELVIL DEWEY, Secretary of the University of the State of New York, has sent out a circular letter stating that Mr. Asa O. Gallup, who has so efficiently discharged the duties of chief clerk for the

past four years, will hereafter represent the University in New York city and will be as fully informed on all matters pertaining to this office as are the officers resident in Albany. He will have all publications, blanks and necessary records for the accommodation of law, medical, dental and veterinary students, and for all the professional, academic and higher examinations conducted by the University. The action of the last Legislature in largely increasing the preliminary and professional examinations under the regents has made a New York office a necessity. The office at 10 East 42d street will be open after September 10, 1895.

The University of Illinois, at Champaign, opened on the 17th of September with one thousand students.

Dr. Walter M. Rankin and Dr. Charles F. W. McClure have been appointed assistant professors of biology in Princeton College.

It is stated that Dr. Nathaniel Butler, of the University of Chicago, has decided to accept the presidency of Colby University.

Dr. Samuel Weir has been appointed professor of the history of education and ethics in the University of the City of New York.

It is proposed to open the new college buildings of the University of the City of New York on October 19th. Mayor Strong, Chancellor of the University of the State of New York, is invited to represent the Eastern colleges. A speaker to represent the colleges of the West and South will also be invited. It is announced that gifts amounting to between $50,000 and $60,000 have been received by the University during the summer.

Henry B. Kümmel, Ph. D. (University of Chicago, 1895), has been appointed assistant geologist on the Geological Survey of New Jersey. His address is Trenton, N. J., instead of the University of Chicago, as heretofore.

Union College began its one hundred and first year on September 19th. The Freshman Class numbers 100. Thirty candidates were refused admission owing to lack of room.

The Freshman Class at Yale University numbers 350 as compared with 338 last year. Princeton College reports a slight increase in the academic departments and a marked decrease in the scientific departments.

The University of St. Andrews is building a hall of residence for its women students on the lines of the Girton and Newnham Colleges at Cambridge and the Oxford Halls for Women. The fee for residence and board for the winter university session of six months will be £40, each student having a separate room. There will be 15 scholarships, all tenable for three years.

The official returns of Swiss universities far the summer semester are reported in *The Lancet* of September 14th. 3108 students and 634 auditors attend the seven universities. Of these students 440 study theology, 648 law, 998 medicine, 1658 philosophy (science and literature). Of the 3108 students 1774 are Swiss, 504 German, 348 Russian, 131 Bulgarian, 56 French, 53 Austrian, 49 Roumanian, 39 Turkish, 39 Italian and 32 American. The greatest number of students attend the Universities of Zurich and Geneva, the attendance being 673 and 665 respectively.

Dr. Herman Credner has been promoted to a full professorship of geology and paleontology at Leipzig, Dr. B. Weinstein to a professorship of physics at Berlin and Dr. Max Vervorn to an assistant professorship of physiology at Jena. Dr. Victor Eberhard, of Königsberg, has been called to fill the chair of mathematics at Halle.

CORRESPONDENCE.

ALLEGED SUPPRESSION OF DISCUSSION.

MR. ERWIN F. SMITH, of the United States Department of Agriculture, has printed a pamphlet on 'The Botanical Club Check List,' of which an abstract contributed by the author was published in the issue of SCIENCE of May 24th, pp. 587–8. In an introduction Mr. Smith writes:

"This paper was offered to the *Botanical Gazette*, passed through the hands of two of its editors, was accepted for publication and announced to appear in the June number. Subsequently it was rejected unless I would submit to have it cut down *two-thirds*. A much briefer statement of the case was previously accepted by SCIENCE, and proof sent to me, after which it was rejected as too long and too personal. Evidently every effort is being made to limit adverse criticism." * * *

An editorial article in the *Journal of Botany* (London) quotes and apparently endorses even more explicit charges of suppression of discussion. In answer to these charges the present writer sent the following letter:

"In the issue of the *Journal of Botany* for July (p. 213) you quote from a correspondent who writes: 'The journals in question will not publish articles which give a true account of what has been said against the American system in Berlin and Vienna. A notice stating the facts was sent to SCIENCE and actually put in type, but the botannical editor suppressed it.' As you state, this is a serious charge, and I venture to ask you to insert this letter denying it. Your correspondent has been misinformed, as no article on the nomenclature question has been rejected by the botanical editor of SCIENCE. The only contribution presented to SCIENCE on this subject and not accepted was an account of an extemporary discussion (partly against and partly in favor of the proposed system) following the reading of a paper before the Biological Society of Washington. This discussion was considered by the undersigned not suitable in form for publication, but the speakers were invited to contribute a discussion of the subject to SCIENCE, and a paper by one of them, Mr. Erwin F. Smith, presenting views similar to those of your correspondent, was contributed by him in abstract and printed in the issue of May 24th."

The *Journal of Botany* has printed this letter, excepting that the beginning has been altered so that the phrase 'as you state' may be omitted. The editor does not, however, withdraw the charges made in his journal.

In regard to the *Botanical Gazette* the editor of the *Journal of Botany* writes:

"We have received a similar communication, which we have unfortunately temporarily mislaid, from the editor of the *Botanical Gazette*, pointing out that articles opposing the neo-American nomenclature have appeared in that journal, and stating that the paper on the subject referred to in the extract we printed was rejected by him on grounds altogether apart from the line of argument adopted. The editor, however, in the number of the *Gazette* just to hand, publishes his justification in terms which are hardly free from the 'personalities' to which he objects in his contribution; and this can be consulted by those who wish to pursue the subject further."

The editorial article referred to is as follows:

"Under the caption 'American nomenclature,' the editor of the *Journal of Botany* prints in the July number a portion of a private letter from some American correspondent in which occurs the following:

"'The only two botanical journals are controlled by reformers. * * * The journals in question will not accept articles which give a true account of what has been said against the American system in Berlin and Vienna. A notice stating the facts was sent to SCIENCE, and * * * suppressed. It was then sent to the *Botanical Gazette*, but was declined.'

"Inasmuch as the editor has sufficient grace to recognize this charge of suppression of the truth as a serious one, it would seem to have been his duty to determine whether it was true or false before publishing it. He could hardly have failed to observe that the *Gazette* has been publishing articles adverse to the reform movement in nomenclature, and had he re-examined them he would have found four of the six on this topic by opponents of reform and only two in favor of it. Another, likewise adverse, is published in this number. We challenge our

readers to say whether this shows a spirit of fairness or a desire to suppress discussion. Does it even indicate an inclination to refuse 'articles which give a true account of what has been said against the American system?'

"So much the editor of the *Journal* could have inferred from the action of the *Gazette*. It is enough to raise at least a presumption that his correspondent's statement was untrue. But he prefers to assume that what the *Gazette* has rejected has been rejected for the purpose of suppressing the truth.

"As a mattor of fact the *Gazette* has rejected but one article on the subject of nomenclature. The article 'suppressed' by SCIENCE was rejected by us because it contained numerous objectionable personalities. In returning the MS. we took pains to inform the author that we objected only to the personalities, *not* to his opinion on nomenclature, and that if the personalities were eliminated the paper would be accepted. When the MS. was returned to the editor, however, it had been so greatly amplified that it would have filled at least thirteen pages of the *Gazette*. It was therefore returned to the writer with a request to condense it, and he was offered any space up to five pages (about the space required by the original paper), but he declined to alter the MS., and finally withdrew it.

"It is difficult to believe that a wish to be fair to what he is pleased to call 'the arbitrary dicta of certain American botanists' animates the utterances of the editor of the *Journal of Botany*. If it does it is at least curious that two scientific men should come to such opposite conconclusions upon the same facts as do Mr. James Britten and a strenuous but gentlemanly opponent whose name we withhold but whose voluntary words we are permitted to quote:

"'I have greatly regretted the ill-natured statements of J. Britten, especially those in which he implies that there has been any unfair suppression of opinion by the *Gazette*. I am confident that whatever has been rejected by the *Gazette* has been refused for the best reasons and for the sake of harmony and the best good of all concerned.'"

It would seem certain from the above that no attempt has been made either by SCIENCE or by the *Botanical Gazette* to suppress discussion of botanical nomenclature. Probably no American journal wishes to suppress discussion, but it is evidently impossible to accept everything presented, and but few journals would care to print an article such as that contained in the July number of the *Journal of Botany*.

J. MCKEEN CATTELL.

BLOOD EXAMINATION IN DISEASE.

THE suggestion of Prof. Le Conte that some notice be taken of articles in which statements are made that are liable to mislead, or that are absolutely erroneous, calls to mind an article in the Scientific American Supplement for May 4, 1895 (p. 16, 126), by Prof. John Michels, entitled "Does a nucleus exist in the red corpuscles of mammalian blood?" In it the following assertion is made:

"It is a remarkable fact that although a knowledge of blood is of such importance and probably the key to a perfect knowledge of the treatment of disease, little or next to nothing is known relating to its physiological properties, its constituents or its effects on the human economy in health or disease. No physician ever makes a microscopical examination of blood in making his diagnosis, and if he did, he would be unable to interpret the appearances he would notice, for there is no guide to the subject, the medical profession remaining under a cloud of ignorance in regard to this matter, and they appear to be content to wait to have this knowledge forced upon them by chemists and biologists, rather than make any effort on their own part to relieve their condition of disgraceful ignorance."

That there still remains much to be learned regarding the blood is undeniable. But that the medical profession is in a state of ignorance in regard to it, or that no one ever makes a microscopical examination of blood in making his diagnosis, is absolutely false. Since the discovery of the hematozoa of malaria by Laveran, in 1880, thousands of cases of malarial fever have been diagnosed absolutely by blood examination. All late books on the practice of medicine refer to this as a valuable aid to diagnosis in this disease. Dr. Wm. Osler, of John Hopkins University, who has made a special study of malarial diseases, can, perhaps, give Prof. Michel some information on this point.

So, too, in cases of anæmia. An examination of the blood will infallibly diagnose the

case, and all physicians in cases of doubt make this examination or have it made. Special instruments like the hæmacytometer of Gowers or Thoma, or the hæmaglobinometer of Gowers, have been made for this purpose and can be purchased from all dealers in microscopical instruments

The disease known as Filariasis can be and is diagnosed by blood examination. The parasites causing this disease occur in the immature state in the blood, passing, as they mature, into the lymphatics. These parasites are truly remarkable from the fact that they are found in the blood only at night, being almost or entirely absent in the daytime; if, however, the patient sleep during the day this is reversed, thus showing that the condition of sleep is an important factor in determining the presence the organisms.

From these facts it would seem that the medical profession is not in quite as 'dense' a state of ignorance regarding the blood as Prof. Michels would have his readers believe, and that they do make use of blood examination in the diagnosis of disease.

JOSEPH F. JAMES.

WASHINGTON, D. C., Sept. 4, 1895.

SCIENTIFIC LITERATURE.

The Science of Mechanics. A Critical and Historical Exposition of its Principles. By DR. ERNST MACH, Professor of Physics in the University of Prague. Translated from the Second German Edition by Thomas J. McCormack. The Open Court Publishing Co., Chicago.

The Science of Mechanics is an English translation of the German treatise by Professor Ernst Mach, on The Development of Mechanics; a work whose ability and importance entitle it to critical attention. While not a complete history of the science, it deals with the subject by the historical method and purports to be a philosophical discussion of the nature, origin and relations of those ideas and principles in mechanics which, when thus linked together, give an intelligible and comprehensive view of the science as it now is, and of the sometimes tortuous way by which it reached its present state. The book as a whole is unique, and is a valuable addition to any library of science or philosophy.

The author's well-known psychological bent is here directed to getting rid of metaphysical obscurities that befog the discussions of the seventeenth and eighteenth century physicists. He presents mechanics as a physical rather than a mathematical science, employing mathematics to some extent, necessarily, but with care not to make of a proposition in mechanics a mere peg on which to hang mathematical formulæ.

After a brief introduction, the work is arranged in a historical view of the development of the principles of statics, to which a hundred and twenty pages are devoted; then about an equal space is given in the same manner to dynamics, this being the order in which the science actually grew up. These divisions overlap somewhat, the former being carried well into the eighteenth century, while the latter begins with Galileo in the seventeenth century, but the order is, on the whole, very satisfactory.

Although the subject-matter of the first chapter may be of less immediate interest than that of the next, yet the author's treatment of it and his philosophical discussion of the early investigators' work and methods of working is most interesting, while the manner in which he shows how a principle has been employed *in essence* by one and another such investigator in its application to special and apparently unrelated questions, before some one makes the happy generalization that gives it the force of a law, is admirable. As one example among others, it is shown how the principle of virtual velocities was made use of by Stevinus in the sixteenth century, and later by Galileo, Torricelli and others before 'the universal applicability of it to all cases of equilibrium was perceived by John Bernoulli,' early in the eighteenth century.

"They that know the entire course of the development of science will, as a matter of course, judge more freely and more correctly of the significance of any present scientific movement than they who, limited in their views to the age in which their own lives have been spent, contemplate merely the momentary trend

that the course of intellectual events takes at the present moment." (p. 7.) The work exhibits this forcibly and repeatedly. Thus, by an extension of the principles employed by Stevinus in the study of hydrostatics, the author deduces a proposition which is now readily recognizable as a special case of Green's Theorem. "We may accordingly," says Professor Mach, "*see into* the force-system of a fluid in equilibrium, or, if you please, *see out* of it, systems of forces of greater or less complexity, and thus reach by a short path propositions *a posteriori*. It is a mere accident that Stevinus did not light on these propositions. The method here pursued corresponds exactly to his." (p. 109.)

The process from special cases to general principles is of course one of economy, and we might expect that any opportunity thus to economize would be at once seized upon. Says the author, "economy of communication and of apprehension is of the very essence of science," and this economy, serving at first to satisfy mere bodily wants, becomes later a potent factor in the development of science in its more advanced and specialized forms. At many points in the book we are reminded of this thesis, but almost immediately after it is stated we are brought face to face with a feature in the history of science that seems in contradiction to it, for after recounting the points which Archimedes, in beginning his study of equilibrium, assumed as self-evident, and then presenting that philosopher's mode of establishing the law of the lever, we are introduced to a succinct statement of the different methods by which Galileo, Huygens, Lagrange and others demonstrated the same law. We may believe that, in part, various philosophers produced new demonstrations because they saw or thought they saw fallacies in the reasoning of their predecessors, but this, we think, is not the principal reason. The fact is rather an illustration of the other fact that, in olden times, a problem once stated, existed, in the estimation of many, for the purpose of bringing out *all the solutions that could be found.* Hence the multiplicity of solutions to various problems as, for example, the many proofs of Euclid's Forty-seventh. There does not seem to be much economy of time or labor in this. Professor Mach recognizes and condemns this tendency, calling it a 'mania for demonstration in science.' It is a fact that variety in the solutions of problems in mechanics led to the development of principles not before recognized, and thus resulted in an expansion of the science. This is shown by Professor Mach where the generalization of the principle of the lever by Leonardo da Vinci brings into prominence the principle of statical moments; and in like manner other advances are introduced, but it was not for the sake of these, nor yet in the interest of economy, that the new demonstrations were produced.

It is shown that the celebrated investigation of the inclined plane by Stevinus virtually involves the principle of the parallelogram of forces, and the principle itself is then stated and the fact commented on that Varignon as well as Newton determined it. The importance of the principle in both statics and kinetics is very properly recognized, but surely it scarcely needs pointing out that the statement and conception of the principle in connection with the parallelogram at this day is not most economical in mental labor or in manual application. It accords well with the cumbersome form in which many statements were made early in the development of science, and in their time the forms were excusable, but that a writer should continue to employ this principle now in the form in which it was enunciated by Newton is not an indication of any economical tendency. For the science has got beyond that. So soon as the idea is accepted that the result of several forces acting simultaneously upon a particle is the same, whether they are considered independently of one another or collectively, the graphic composition of the forces by vectorial addition becomes at once the simplest and most rational method. This, for two forces and their resultant, gives the triangle and dispenses with the parallelogram and diagonal idea altogether, besides serving equally well for three forces in equilibrium. As good a treatise on mechanics can be produced to-day without any reference to the parallelogram of forces as with it, and such is now the tendency. If the idea of 'economy of communication and of apprehension' is to prevail we must carry out this ten-

dency, but it will be done, if at all, only after an unduly prolonged, wasteful adherence to the parallelogram.

In treating of the development of dynamics, attention is confined principally to the achievements of Galileo, Huygens and Newton. The exposition of the work of Galileo is excellent, marking out in clearest lines his superiority as a truly scientific investigator over all his predecessors and most of his successors. His greatest work, of course, was his determination of the laws of falling bodies, and consequently of uniformly accelerated motion. In everything concerning the relation of motion to the circumstances that affect it, Galileo had to make his way as a pioneer. After first examining whether the velocity of a falling body varied directly as the distance, and abandoning this for the assumption that it varied as the time, he was led to a correct idea of acceleration, and also to that of force as measured by the product of mass and acceleration. Owing to the physical limitations under which he was obliged to perform his experiments, it was necessary for him to make various assumptions, whose validity always had to be proven. For instance, he retarded the motion of falling bodies by causing them to descend inclined planes, and then examined the peculiarities of their motion upon the assumption that "a body which falls through the height of an inclined plane attains the same final velocity as a body which falls through its length."

The reasoning by which he felt warranted in in making this assumption brought him to the conclusion that if a body, in falling down the length of an inclined plane, acquired a velocity different from that gained by falling through its height, "a heavy body could, by an appropriate arrangement of inclined planes, be forced continually upwards solely by its own weight." But besides justifying the assumption logically he verified it experimentally. Both his reasoning and his experimentation were confined to the action of single bodies. Later, when Huygens solved the problem of the centre of oscillation of a compound pendulum he made use of a principle which, in its ultimate nature, was like that employed by Galileo, as follows: "In whatsoever manner the material particles of a pendulum may by mutual interaction modify each other's motions, in every case the velocities acquired in the descent of the pendulum can be such only that by virtue of them the centre of gravity of the particles, whether still in connection or with their connections dissolved, is able to rise just as *high* as the point from which it *fell.* Huygens found himself compelled, by the doubts of his contemporaries as to the correctness of this principle, to remark that the only assumption implied in the principle is that heavy bodies of themselves do not move upwards;" (p. 174), and this principle, as Professor Mach points out, is *a generalization of one of Galileo's ideas.*

The author regards Huygens as in every respect the peer of Galileo, a rank which perhaps few would deny him. The above principle which he introduced makes what we now call the *work* done on a body by gravity, the condition determinative of the velocity it acquires, and this, more than anything else, marks the difference between Huygens' point of departure and that of Galileo and of Newton. All three recognized the fact of accelerations which they ascribed to *force* as a cause whose nature was unknown. Says the author: "That which in the mechanics of the present day is called *force* is not a something that lies latent in the natural processes, but a measurable, actual circumstance of motion, the product of the mass into the acceleration." (p. 246.) But this product is only one way of measuring the mutual actions involved, for not only do bodies influence one another as to velocities, but also as to displacements, and either of these may be made the basis of measuring the force. "We may, therefore, as it suits us, regard the *time* of descent or the *distance* of descent as the factor determinative of velocity. If we fix our attention on the first circumstance, the concept of force appears as the original notion, the concept of work as the derived one. If we investigate the influence of the second fact first, the concept of work is the original notion. * * * In this case we know force only as the limiting value of the ratio which increment of work bears to increment of distance.

Galileo cultivated by preference the first of these two methods. Newton likewise preferred

it. Huygens pursued the second method, without at all restricting himself to it." (p. 250.)

When we recollect that the adoption of 'work' as the fundamental concept of mechanics by J. R. Mayer, scarce a half century ago, was the introduction of modern views and methods in physics, and that when Professors Clifford and Tait, in still more recent times, were wont to dwell upon the consideration of force as a space-rate of change in work or energy (or potential), their ideas were regarded as novel and rather disturbing, it is refreshing to find Huygens ranged alongside of the nineteenth century physicists, though chronologically sandwiched between Galileo, who founded the science of dynamics, and Newton, of whom the author says, 'since his time no essentially new principle has been stated.' But, as Professor Mach reminds us, Huygens' principle was by no means well received by his contemporaries, notwithstanding it was his chief performance.

Naturally the achievements of Newton come in for the largest share of attention. The extent of his achievements and the profound and lasting impression which they made upon science compel, in any critic, the most searching scrutiny. It is necessary, too, to distinguish those discoveries and reflections which are Newton's own from those which he accepted from his predecessors and made more available by his clear perception of their relation to physical science in general and by his lucid formulation of them in laws and principles. This distinction has been made many a time, and doubtless many a one has wished to protest against certain of Newton's views, but it must be admitted that except for the old fashioned form of his statements, and the geometrical form of the demonstrations, surprisingly little of his writings has been altered to advantage. So far as his investigations are confined to facts, with abstention from every form of speculation, that is, so far as he conforms strictly to his assertion that he does not frame hypotheses, Professor Mach finds little but pleasure in his great work, and only objects to its form. But in his famous view concerning absolute time, space and motion, Newton departs from a consideration of physical facts, enters into psychology and, in the estimation of the author, makes statements and distinctions that are not justifiable and which he criticises severely. Yet after reading the fifty pages or more that are devoted to the rather unfavorable consideration of Newton's fundamental statements in mechanics, one cannot help feeling that the last word on the subject has by no means been said. When the author says, "We arrive at the idea of time, to express it briefly and popularly, by the connection of that which is contained in the province of our memory with that which is contained in the province of our sense perception," we feel that Maxwell's statement that the idea of time originated probably 'in the recognition of an order of sequence *in our states of consciousness*' is an improvement in form upon the author's, and is more satisfactory, while conforming much more nearly to the Newtonian conceptions. As substitutes for Newton's enunciations Professor Mach offers three experimental propositions and two definitions as being 'much more simple, methodically better arranged, and more satisfactory.' In so far as his criticisms are endorsed the substitute propositions might be approved in substance, but their form savors of pedantry and they have the defect of excessive conciseness; they are therefore technical, and in consequence they require, each on its own account, a good deal of explanation. They can only be called simple for those who are already pretty well aware of what they state, but they prepare us for the remark: "We join with the eminent physicists Thomson and Tait in our reverence and admiration of Newton. But we can only comprehend with difficulty their opinion that the Newtonian doctrines still remain the best and most philosophical foundation of the science that can be given." (p. 245.)

A chapter is devoted to the extension of the principles, in which the reader will find an interesting treatment of the controversy between Descartes and Leibnitz, with their respective followings, over the conservation of momentum and of *vis viva*, with D'Alembert's final adjustment of it. The merits of D'Alembert's principle are enlarged upon we think justly, it being shown to embody within it all that is involved in Gauss' principle of least constraint. The work abounds in such comparisons and analyses as, after an

account of Clairaut's treatise on the figure of the earth, we learn that 'in the theory of Clairaut here presented is contained, beyond all doubt, the idea that underlies the doctrine of *force-function* or *potential*, which was afterwards developed with such splendid results by Laplace, Poisson, Green, Gauss and others.' (P. 398).

In the section on mechanical units, adapted to American usage by Mr. C. S. Peirce we notice the suggestion that the unit of acceleration be called a 'galileo,' as one more contribution to supply 'a long felt want.' The suggestion is at once adopted in the illustrations that follow.

Under 'The formal development of mechanics' is presented a view of the characteristic *classes* of problems that have arisen. This, together with a discussion of the various points of view, theological, animistic and mystical, of the great investigators, a section on analytical mechanics, and one on the economy of science, makes a most readable and enjoyable chapter.

The final chapter treats of the relations of mechanics to other departments of science, and is the least satisfactory one in the book. It opens with the declaration that "purely mechanical phenomena do not exist;" an arbitrary assertion which is explained by the equally arbitrary one that 'with dynamic results are always associated thermal, magnetic, electrical and chemical phenomena.' The statements are arbitrary because there is no proof of them. The author deprecates explaining all physical phenomena by mechanical ideas, saying, "we have no means of knowing, as yet, which of the physical phenomena go *deepest*, whether the mechanical phenomena are perhaps not the most superficial of all, or whether all do not go equally deep." Precisely; and for that reason, if for no other, we would take exception to the opening remark quoted above. Even if it were shown that no supposed mechanical phenomenon occurred without one or more of the other effects mentioned, the proposition would be by no means proven. Attraction, repulsion and strain are the very essence of mechanics and it is by no means certain that they are not the essence of other branches of physics also. There is nothing to show that magnetic, electrical and even chemical phenomena may not be ultimately and purely mechanical in their nature.

The translation is occasionally very free, but generally faithful to the meaning of the original, and only varied from it in form, to make the statements more lucid. This effect is heightened by the insertion of several brief notes by the translator.

Reproductions of quaint old portraits and vignettes give piquancy to the pages. The numerous marginal titles form a complete epitome of the work; and there is that invaluable adjunct, a good index.

Altogether the publishers are to be congratulated upon producing a technical work that is thoroughly attractive in its make-up.

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On a Collection of Mammals from Arizona and Mexico, made by W. W. Price, with Field Notes by the Collector. By J. A. ALLEN. Bull. American Museum Natural History, vol. VII., pp. 193–258, June 29, 1895.

This important paper is based chiefly on a collection of 1500 specimens of small mammals obtained by W. W. Price in 1894 in southeastern Arizona. Mr. Price contributes an itinerary and descriptions of localities at which collections were made—a useful feature too often omitted in faunal papers. He also attempts to define five life zones, but fails to correlate them with the zones now commonly recognized in the region. His *first* is wholly Lower Sonoran; his *second* comprises the upper part of the Lower, and lower part of the Upper Sonoran; his *third* is the upper or *juniper belt* of the Upper Sonoran; his *fourth* is the Transition, and his *fifth* the Boreal.

The annotated list of mammals by Dr. Allen, with Mr. Price's field notes, covers 58 pages and is a great addition to the published record of our knowledge of Arizona mammals. Several changes in nomenclature are made and one species is described as new (*Thomomys cervinus*, a pocket gopher from Phœnix). The other new forms were described by Dr. Allen in a previous paper. *Perognathus conditi* and *Perodipus chapmani* are allowed to stand as species, although it has not been shown how the former differs from *Perognathus paradoxus*, or the latter from *Perodipus ordi*.

All of the wood rats are lumped under a

single species, *Neotoma mexicana* Baird, and the extraordinary opinion is expressed that *N. albigula* Hartley 'is not separable from *N. mexicana*.' Here, as in a previous paper, the author shows himself hopelessly at sea. *Neotoma albigula* and *N. mexicana* not only inhabit different life zones but belong to different groups or subdivisions of the genus!

The Arizona form of the Plains Prairie Dog is given as a distinct species, but anyone who will take the trouble to compare it with specimens from New Mexico and Texas will see that at most it is only a subspecies. On the other hand, the long-eared Arizona Jack Cottontail is given as a subspecies, though very distinct from any other known rabbit.

By curious lapse of memory the round-tailed spermophile (*Spermophilus tereticaudus*) is allowed to remain in the subgenus *Ictidomys*—a subgenus erected by Dr. Allen in 1877 for species with narrow elongate skulls. The species originally referred to it are *tereticaudus*, *tridecemlineatus* and *franklini*. *S. tereticaudus* has one of the shortest and broadest skulls known in the whole genus *Spermophilus*, but, probably by accidental transposition of skulls, it was described by Dr. Allen as long and slender. When his attention was called to the matter he very properly withdrew *tereticaudus* from the group and suggested that *13-lineatus* be taken as the type of *Ictidomys*, no type having been designated in the original description. But in the present paper the short skulled *tereticaudus* is again placed in *Ictidomys!*

Say's ground squirrel (*Spermophilus lateralis*) is persistently referred to the genus *Tamias*—a genus with which it has no affinity whatever and to which it bears only the most superficial resemblance.

With respect to the white-footed mice of the *Peromyscus sonoriensis* group, it is not likely that the last word has been said.

The generic name *Adelonycteris*, adopted from Harrison Allen for the large Brown Bat, has no claim for recognition, being antedated by at least two names of equal pertinency.

The specific name now in current use for the Mountain Sheep (*Ovis canadensis* Shaw) is replaced by *O. cervina* Desm. without apparent reason. Both names were published in 1804, but there is no evidence that *cervina* antedates *canadensis*. In the absence of positive proof of priority such changes are most unfortunate and not likely to stand.

Passing from technical matters to the substance of the paper, one finds much of interest and numerous previously unpublished records. And it is gratifying to learn that elk still inhabit the White Mountains on the boundary between Arizona and New Mexico, where one was shot August 10, 1894. It is to be regretted that the specimen was not preserved.

C. H. M.

La sensibilité de l'œil aux coleurs spectrales. M. PARINAUD. *Revue Scientifique*, Sér. 4, T. 3, 709–714. June 8, 1895.

In a recent number of the *Revue Scientifique* Parinaud gives the results of certain interesting experiments upon the relative sensitiveness of the eye to spectral colors seen under different conditions of retinal adaptation. Two degrees of adaptation were used, one that of the eye in ordinary vision, the other that of the eye from which light has been completely excluded for 20–30 minutes. The following little table gives

Condition of the Retina.	A	B	C	D	E	F	G	H
20–30 min. darkness...	?	$\frac{1}{400}$	$\frac{1}{100}$	$\frac{1}{10}$	1	1	$\frac{1}{100}$	$\frac{1}{250}$
Ordinary conditions...	?	$\frac{1}{400}$	$\frac{1}{100}$	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{500}$	$\frac{1}{1500}$	?

the general results of the experiments, the letters standing for the Fraunhofer lines. While the figures are not to be taken in any sense as absolute, there are several interesting relations that appear in them.

The red end of the spectrum, for example, appears wholly unaffected by adaptation, though the place of greatest brightness shifts decidedly toward the violet. It was observed further that, with the adapted eye and the low intensities of light used with it, colors from the yellow onward to the violet (*i. e.*, the colors which are influenced by adaptation) appeared colorless; in other words, adaptation of the eye decreases the saturation of the colors seen until they at last appear entirely white. The red end is seen as red if seen at all. A third observa-

tion was that no adaptation whatever exists in the *fovea* (retinal point of clearest vision). It is consequently blind to lights that are yet easily seen by adjacent regions, and all colors are seen by it as colors if seen at all. The relations of these observations to color theories the author has reserved for succeeding papers. It is to be regretted that M. Parinaud has not coördinated his work with that of von Bezold, Hillebrand, König, Christine Ladd Franklin and others, who have, one or another of them, made all or nearly all of these observations before. E. C. SANFORD.

SCIENTIFIC JONRNALS.

THE PHYSICAL REVIEW, VOL. III., NO. 2, SEPTEMBER–OCTOBER.

A Study of the Polarization of the Light Emitted by Incandescent Solid and Liquid Surfaces: By R. A. MILLIKAN. In spite of its important bearing upon the whole theory of radiation, the subject of polarization by emission appears to have been heretofore almost wholly neglected. As is pointed out by Dr. Millikan in the brief historical introduction to his own observations, no quantitative study of this subject has yet been made; and even qualitative observations appear to be rare. Having a clear field, Dr. Millikan has therefore undertaken a thorough investigation of the phenomenon. Experiments were first made in order to make certain that the effect is not due to refraction through the heated air at the incandescent surface. For this purpose a piece of platinum foil was brought to incandescence *in vacuo*. The light emitted showed the same degree of polarization as was observed when air was present. It thus appears that the polarization occurs within the radiating body.

Qualitative observations were next made upon a great variety of substances, in order to determine to what extent the phenomenon depends upon the nature of the surface. In all cases it was found that the polarization was in a plane perpendicular to the plane of emergence. Most metals showed a strong polarization, especially at grazing emergence; and provided the surfaces were not altered by oxidation, the behavior of molten metals was similar to that of solids. Non-metallic substances, such as glass and porcelain, showed the effect in less degree than did the metals. The transparency or non-transparency of the material appears to have little influence upon the amount of polarization observed. For quantitative observations the author used the polariscope of Cornu, an instrument quite simple in construction and yet capable of considerable accuracy. The present paper contains a discussion of the sensitiveness of the instrument, together with a few observations made with it; but the discussion of most of the quantitative work is postponed until the second half of the paper, which will appear in the November number.

Alternating Currents when the Electromotive Force is of a Zigzag Wave Type. By E. C. RIMINGTON. Of course no dynamo will give an E. M. F. curve of the zigzag form. Nevertheless when certain harmonics are present in unusual prominence this shape of curve is sometimes approached. Mr. Rimington has investigated the relation between current and electromotive force in an inductive circuit for the ideal case, in order to be able to predict roughly what will occur in practice. The mathematical methods used are novel, and results are obtained in such form as to be readily available for calculation. Perhaps what will most strongly appeal to the reader are the diagrams giving the curves of electromotive force current for certain assumed values of the resistance and inductance. Diagrams are also given for the case of an E. M. F. curve of the rectangular type.

On Ternary Mixtures. By W. D. BANCROFT. This is a continuation of an article begun in the July number, which has already been noticed in SCIENCE. Further abstract will be postponed until the article is completed.

On a Simple Method of Photographically Registering the Infra-Red Energy Spectrum: By KNUT ÅNGSTRÖM. In this paper are described two forms of apparatus for obtaining autographic bolometer records, the results achieved being similar to those obtained by Langley in his recent work on the infra-red solar spectrum. Dr. Ångström makes no attempt to improve upon the elaborate apparatus of Langley, the wonderful results of which he does not hope to equal. But, as he very truly remarks, "such

an instrument can only be obtained by a richly endowed laboratory." His object is, therefore, to simplify the method so as to bring the apparatus within the reach of laboratories of only moderate equipment. The method proposed can scarcely be described here. Tests made with it in recording the infra-red spectra of various flames, appear, however, to be satisfactory. The author's aim can perhaps best be stated in his own words: "To construct an apparatus which shall bear the same relation to that of Langley as does the direct vision spectroscope to the larger instruments of its class."

On the Electrolytic Conductivity of Concentrated Sulphuric Acid: By K. E. GUTHE and L. J. BRIGGS. The authors have determined the conductivity of strong sulphuric acid at different temperatures and concentrations, with especial reference to the concentration corresponding to the hydrate $H_2SO_4+H_2O$. Measurements were made by the bridge method with an alternating current, a sensitive dynamometer being used instead of a telephone. The results are given in tables, and also in the form of four curves, which show the relation between molecular volume and molecular conductivity at temperatures of 0°, 10°, 18° and 25°. Each of the four curves has a well-marked minimum at the molecular volume 32.1. If curves are drawn with concentrations instead of molecular volumes the minima do not occur at the same points. From this the authors draw the important conclusion that 'it is not the concentration but the molecular volume which determines the conductivity of the acid.' Interesting results are obtained for the conductivity of the crystalline hydrate $H_2SO_4+H_2O$. The values obtained are perfectly definite, and appear to be free from errors due to the presence of unsolidified acid. The conductivity is found to be much smaller than that of the liquid, even when the latter is undercooled. A rapid diminution in resistance is, however, noticeable as the temperature approaches the melting point (7°.5).

Book Notices. HELM: Grundzüge der Mathematischen Chemie. OSTWALD'S Klassiker der Exacten Wissenschaften. MACH: Popular Science Lectures. Proceedings of the Electrical Society of Cornell University. NABER: Standard Methods in Physics and Electricity criticised.

NEW BOOKS.

A Text-book of the Principles of Physics. ALFRED DANIELL. 3d Edition. New York and London. 1895. Pp. xv+782. $4.00.

The Great Frozen Land. FREDERICK GEORGE JACKSON. London and New York, Macmillan & Co. 1805. Pp. xviii+297. $4.50.

Climate and Baths of Great Britain. (Vol. I.) Being the report of a committee of the Royal Medical and Chirurgical Society of London. London and New York, Macmillan & Co. 1895. Pp. xvi+640. $6.50.

The Practice of Massage. A. SYMONS ECCLES. New York and London, Macmillan & Co. 1895. Pp. xii+377. $2.50.

The Theory and Practice of Counter Irritation. H. CAMERON GILLIES. London and New York, Macmillan & Co. 1895. Pp. xii+236. $2.50.

The Production of Tin in Various Parts of the World. CHARLES M. ROLKER. Washington. Government Printing Office. 1895. Pp. 88.

Handbuch der Physiologischen Optik. H. VON HELMHOLTZ. 2d Edition, Nos. 1–10. Hamburg und Leipzig, Leopold Voss. 1886–1895. Pp. 800.

Graduate Courses. Compiled by an editorial board of graduate students. New York, Macmillan & Co. 1895. Pp. vi+135. 25 cts.

Proceedings of the Royal Society of Victoria. Vol. VII., New Series. London, Williams and Norgate. 1895. Pp. vi+339.

The Psychology of Number. By JAMES A. MCLELLAN and JOHN DEWEY. New York, D. Appleton & Co. 1895. Pp. xiv+309. $1.50.

The Beginnings of Writing. WALTER JAMES HOFFMAN. New York, D. Appleton & Co. 1895. Pp. xiv+209. $1.75.

Frail Children of the Air. SAMUEL HUBBARD SCUDDER. Boston and New York, Houghton, Mifflin & Co. 1895. Pp. viii+279. $1.50.

Alternating Electric Currents. EDWIN J. HOUSTON and A. E. KENNELLY. New York, The W. J. Johnston Co. 1895. Pp. 225. $1.00.

The Stone Industry in 1894. WILLIAN C. DAY. Washington, Government Printing Office. 1895. Pp. 83.